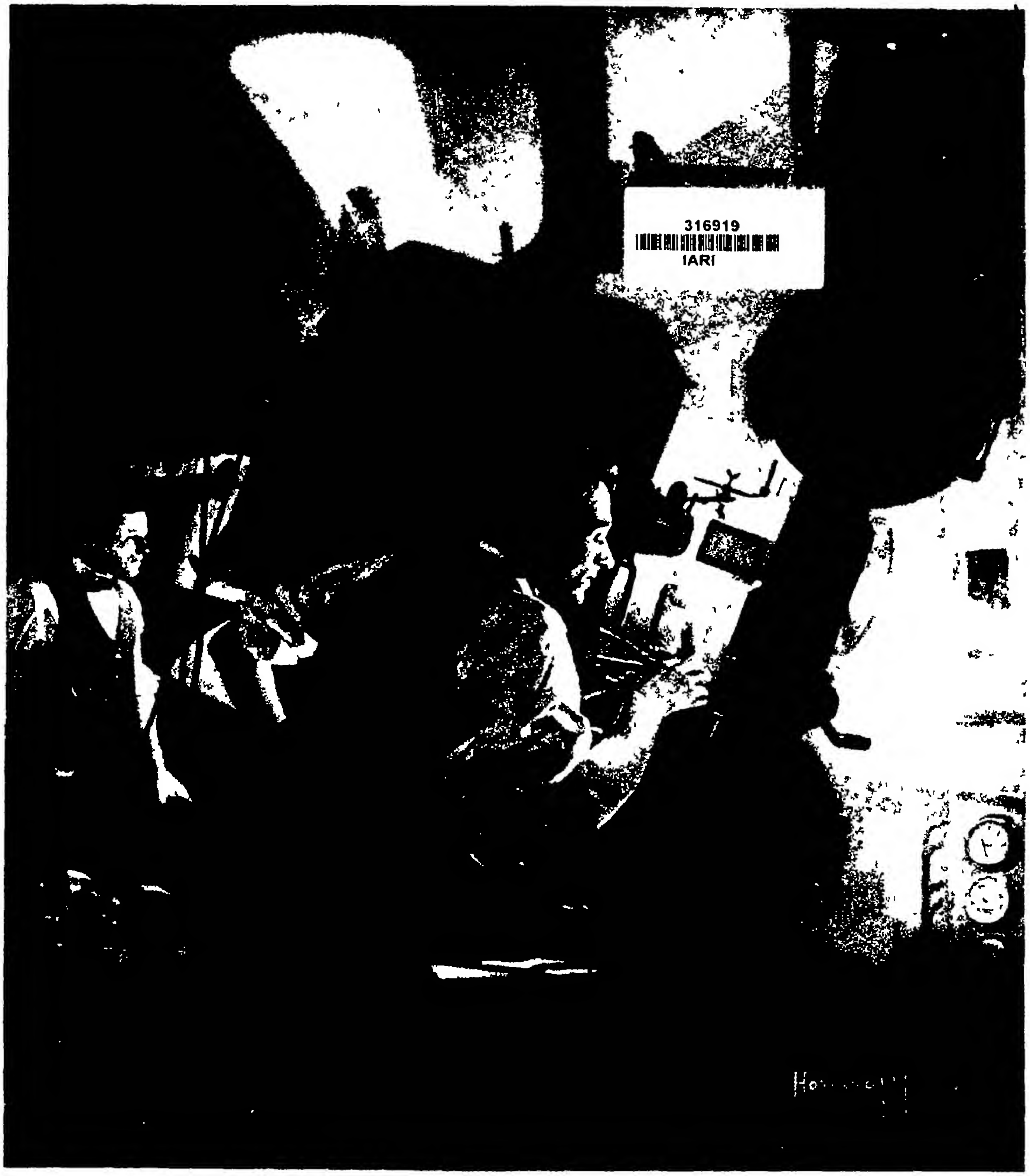
IN THIS ISSUE: [illegible] T TO BE BOMB OR BATTLESHIP?
ANIMAL TISSUE THAT DOES NOT DIE

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY SCIENCE INVENTION MECHANICS



THE MAN BEHIND THE PICTURE: PROJECTION BOOTH OF A MOTION PICTURE THEATER

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SEVENTY-SEVENTH YEAR

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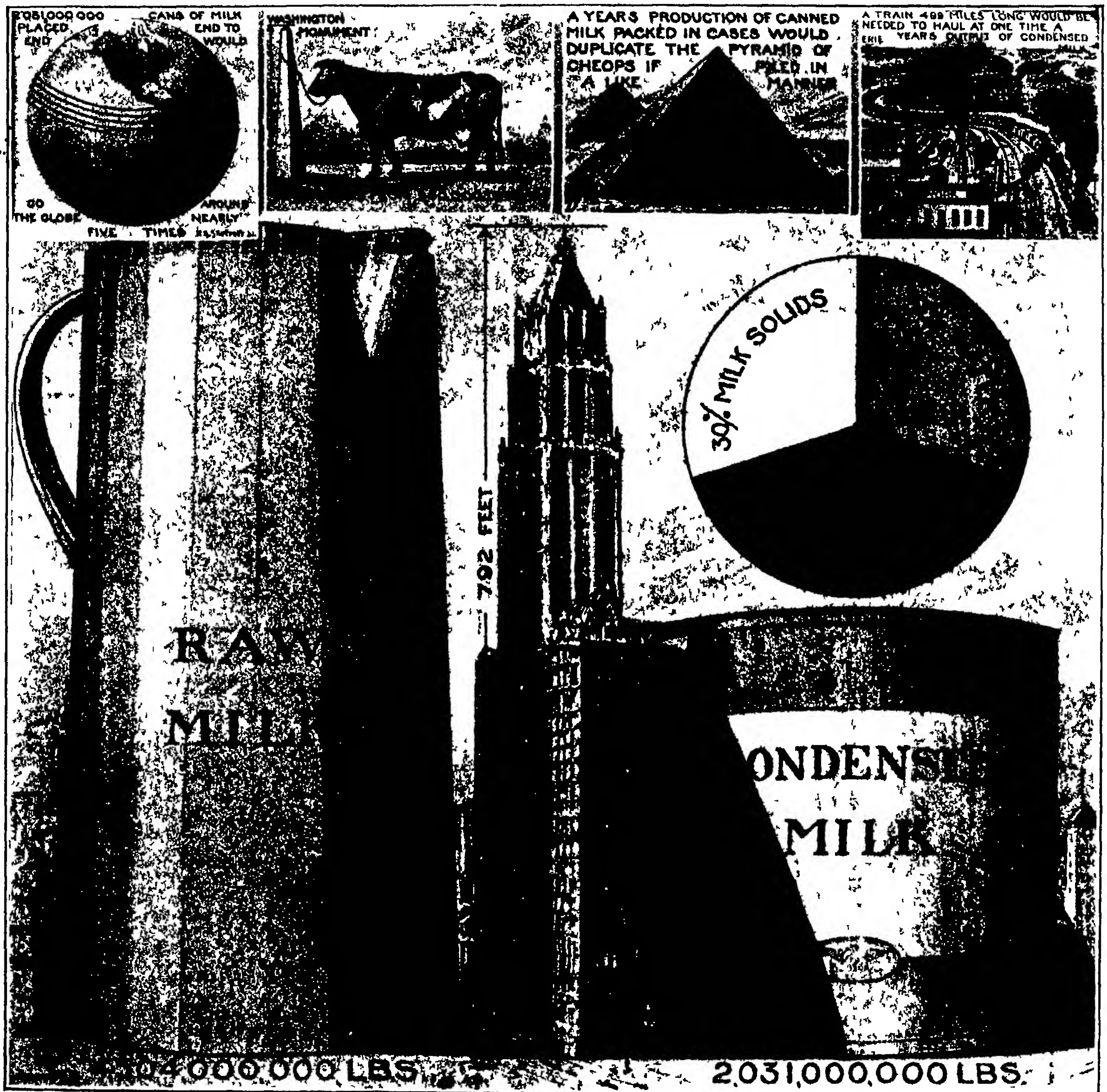

SOME GRAPHIC COMPARISONS OF OUR CONDENSED MILK INDUSTRY, SUCH AS NUMBER OF CANS AND COWS, VOLUME OF PACKING CASES AND FREIGHT, AND RELATIVE BULK OF RAW MILK AND CONDENSED MILK, TOGETHER WITH CONSTITUENTS OF LATTER—(See page 11)

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The Limitations of Aerial Bombing

NAVAL officers point out that there have been appearing in the press with increasing frequency erroneous statements respecting the cost of battleships as compared with aircraft It is also claimed that aerial bombs are more destructive than gun projectiles because such bombs contain a larger percentage of explosive than armor piercing shells of the same size The statements most frequently made with respect to costs are that 1,000 airplanes can be constructed for the cost of one present day battleship, that each plane can carry a bomb of sufficient power to sink a battleship and that the air plane requires a personnel of only two or three men, whereas the battleship requires 800 or more

In the first place present day cost of battleships due to lower prices is less than $45 000 000 but granting the cost to be that sum and that such a battleship could be used for the first line for a period of 15 years and the second line for ten years, at an annual upkeep cost of $1 000 000 the cost of the battleship for 25 years would be $70 000 000, or $2,800,000 yearly Granted that 1,000 planes can be built for $45,000 000—which, on account of the diversified types required by complete naval air force seems hardly possible inasmuch as planes of the larger type cost considerably more than $45,000 each, including their equipment—it should be borne in mind that the life of a plane in service is approximately two years Hence the entire cost of the planes must be again spent each succeeding two years, or 12½ times during the life of a battleship, and inasmuch as not less than 50 per cent on the average of the first cost of a plane is required to keep it in commission for two years the total cost of 1,000 planes for 25 years would be $843,750 000, or $33,748,000 per year, a sum sufficient to keep in commission 12 battleships of the present-day type

Furthermore, in the matter of personnel, Naval officers do not agree with the printed statements A battleship such as contemplated would have a crew of 1,500 officers and men instead of 800, while in the case of airplanes for every man in the air there is required approximately 20 on the ground On this basis, 12 battleships would require 18,000 officers and men and 1,000 airplanes, on the basis of one man in the plane and 20 on the ground, would require 21,000 personnel To be perfectly fair in the matter, it may be considered that the personnel of the two would about cancel each other in cost, inasmuch as highly skilled mechanics are required on battleships and aircraft alike In the case of landing fields and hangars for 1 000 aircraft we may also consider that the expense is canceled by docks and navy yards required for the repair of battleships That brings the case down to a comparison of material cost, and as above stated, 1 000 aircraft stretched over a period of 25 years, which is the extreme life of a battleship, would equal the cost of 12 such battleships

Regarding the statement that aircraft could each carry a bomb sufficiently large to destroy a battleship, it is not believed that at the present day this can be done Bombs have not been developed to such an extent that they are armor piercing, and after landing on the deck of a ship their destructiveness would be local The experiments on the U S S "Indiana" with a large bomb filled with T N T which was exploded on her deck causing considerable damage to her old style upper works has been used as an illustration of what bombs can do, and statements have been made that if the bomb were destructive when laid on the deck, it would be much more so if dropped from an airplane. This is erroneous The destructiveness of T N T., unconfined, has a certain potentiality which is not increased by the mere dropping of the T N T from a height *It is necessary for the projectile to pierce the armor of the ship and explode inside of her hull* This cannot be done by thin walled aerial bombs subject only to the impulse of gravity There must be acceleration beyond the force of gravity to cause the shell to pierce armor and the shell must be of the armor piercing variety, consequently, the weight of the shell wall reduces the amount of T.N T which it may contain, reducing the destructiveness of the bomb

It is believed that the actual facts should be given the public Erroneous comparisons which only bring out one side of the argument do not help the cause of aeronautics but do more harm than good

The Lampert Bill

THE United States Congress passes, each year, appropriation bills designed to give the various branches of the Government funds for the year s operations. In part these appropriations are a matter of negotiation between the Bureau in question and the Committee of the House of Representatives involved In equal part they have their basis in statutory provision as to how many men may be employed and at what salaries

Present salaries in the Patent Office date back to 1848, at which time the patent examiner got the salary of a Federal District Judge Today the Judge gets $6 000 the examiners have had a single increase of 10 per cent, and a $240 war bonus, they now get considerably less than half the pay of the judges with whom they were once on an equal footing If comparison of qualifications is to be made, the requirements of the Patent Office are by all means harder to meet And as for professional dignity, patent examination is in many respects juridical work, and should be compensated as such

Turning from the question of salaries, we find that the Patent Office is seriously under manned Not alone has patent business been increasing by leaps and bounds until it is larger than ever before, the older and more experienced examiners have resigned in large numbers to enter commercial employment or private practice, and it takes two years of continual attention from his superiors to render a newly appointed examiner really competent This explains why the Patent Office is 46,000 cases behind its schedule, so that if you file an application for a patent today you must wait seven months to get the preliminary report telling what the examiner thinks of it

The Committee on Patents of the House of Representatives is picked on geographical and political grounds If it is desired to have a Republican from Maryland and a Democrat from Kansas on this committee on they go regardless of qualifications to deal with patent business. When a new Congress convenes, the best part of the new committee's time for months is spent in educating its new members—and sometimes its old members—as to what and why is a patent The hearings of this committee always bring forward some absurd questions from its members, showing fundamental misunderstanding of the entire patent system

We shall not argue these matters here, we have nothing to add to what we have said in the past. We shall only state that the Lampert Bill, which had a deal of attention from the Patents Committee of the old Congress, is up again in the new one It provides proper salaries and an adequate staff for the Patent Office Last time it was talked to death as much by its friends as by its enemies There is no reason in the world why it should fail this time, and, in fact, it has excellent prospects of passing When we find that the total payroll of the Patent Office, in the event of its unamended passage, will be but $1,951,840, it is clear that at least the wild cry of "economy" cannot be raised against it. In justice to the inventors and the manufacturers of America as well as to the Patent Office staff, it should be passed

Relativity in 1889

THE ancients had a pretty myth about Minerva, the goddess of wisdom, whom they stated to have sprung, full-grown and full panoplied, from the head of Jove There is more in this legend than appears on the surface Divine wisdom, perfect and boundless, if we conceive it ever to have had beginning at all, must thus have come into full being We today should prefer to think of it as without beginning, as having always been, but that may be let pass. The ancient philosophers, at the period when they were still engaged in the personification of their ideas, had without exception failed to grasp the concept of infinite reaches of time—they still felt obliged to account for the beginning and the ending of things.

Human wisdom, unlike Minerva, never springs full-grown into being, but arrives at a given point, if we may mix our metaphors, only by a long and arduous process of toiling up the slopes. In the myth of Minerva the Greeks had in mind this essential distinction between the wisdom of the gods and that of the finite human mind No single item of human knowledge, no single human doctrine, ever was formulated out of nothing in a single mind Every such item is the result of slow growth and accretion, and in its final form contains the contribution of many minds. Ultimate formulation is often the work of a single intellect, but this intellect draws its material from the entire past history of the race The historian of human thought finds it an absorbing business to pursue some great idea back through its ultimate sources. And always when we conduct this search we are amazed by the degree to which the work of the man who is recognized as the originator consists merely in restating in better form, and in a single place, things which have been said before in fragmentary fashion

The apostles of Einstein, for instance, have realized well that in many respects this relativity of which we are all talking is but another instance of old wine in new bottles The very phrase "classical relativity" with which so many of them introduce their subject indicates that its fundamentals are by no means new It is the interpretation of the theory and its unique mathematical formulation that are Einstein s Nevertheless we are inclined to regard as novel some of its more startling philosophical aspects Some of them indeed are novel, the General Theory we believe is so, and even in the Special Theory, the assumption that light displays the same velocity to all observers however conditioned could not have been thinkable until twentieth-century physics had given a background of experiment and theory leading to the suggestion But the very charges of plagiarism brought against Einstein, while absurd in principle, indicate that he has been building with old material to a greater extent than may have been realized This, we reiterate, is the very nature of things. We must admire those who have supplied the material, who have anticipated parts of the structure which Einstein has reared We must not on this ground condemn Einstein.

Such anticipations are as interesting to the philosopher as they are important to the historian of science It is with mingled emotions of the philosopher and the historian that we reprint, in the SCIENTIFIC AMERICAN MONTHLY for July, an article which originally appeared in the SCIENTIFIC AMERICAN SUPPLEMENT of May 11, 1889 It is signed by a name which today is familiar to us all, but which thirty two years ago must have been a new one to most of those who saw it in our columns—Hudson Maxim

When we go back to this article, bearing with us the knowledge and the general scientific background of today, our reactions are curiously mixed Mr Maxim used the expression "ultimate atom" Ultimate particle would have been more in keeping with modern usage. The twentieth-century mathematician who assumes things to be true because he can find nothing simpler in terms of which to prove them, and who deliberately chooses the things which it pleases him to assume, will quarrel with Mr Maxim's statement of axioms on the ground of natural truth and obviousness. But he cannot deny the axioms themselves, nor, having granted these, can he quarrel with the conclusions.

In many of its fundamentals every reader will recognize that we have here an effort to state, so far as the mental horizon of 1889 would encompass it, the philosophical outline of Einstein's Special Theory It is on this account, as well as because Mr Maxim wishes it put before the present generation in black and white as a preliminary to something further which he has to say, that we reprint it in the MONTHLY for July.

Naval and Merchant Marine

Lighting of Ships at Sea.—Several interesting problems were discussed at the last meeting of the Illuminating Engineering Society Among the special problems discussed was that of lighting the charthouse and compass-dials. Concealed lighting is recommended, an approved method being the lighting of charts mounted between sheets of glass by diffused light transmitted from below Some members favored the use of lights on deck if the sources of light could be screened.

One-third of American Crews Native.—A recent report of the Department of Commerce, giving a list of the nationalities of the crews of American merchant vessels, discloses the gratifying fact that nearly one-third of the crews of American ships are native-born Thus, out of 25,204 officers, 10,808 are native-born, and 6,965 are naturalized citizens Of 155,024 men, 50,966 are native-born and 10,898 are naturalized citizens. Of foreigners, the British account for 518 officers and 21,261 men, the Norwegians for 263 officers and 5,038 men, and 43 officers and 16,528 men are Spanish.

The Trials of the "Tennessee."—The battleship "Tennessee," our latest electrically-driven dreadnaught, has recently passed successfully through her final trials off Rockland She bettered the Westinghouse Company's guarantees of steam consumption by about seven per cent. The maximum speed was 21.38 knots, and she was brought to rest from top speed in less than three minutes. The salvo tests, in which twelve 14 inch guns were fired at once, caused no injury to her electrical equipment Going astern she developed 15 knots, and her turning radius, with all propellers operating and rudder hard over, was about 700 yards

Rapid Work on City Piers.—It is announced that the first of the twelve piers which are being built at Staten Island will be ready for occupancy on August 6th Murray Hulbert, Commissioner of Docks and Ferries, is to be congratulated upon the rapidity of the work All of the piers will be ready by the end of the year Seeing that the first pile was driven on May 5, 1920, this speeding up is in strong contrast to the dilatoriness which almost invariably distinguishes city construction The piers are over 1,000 feet in length, ten of them have single-story and the other two double-deck pier sheds, and they have the advantage that there is a bay between the piers 300 feet in width

Results of Naval Bombing Tests.—Without wishing to detract from the work of the naval airmen in sinking a German U boat early in the first bombing test, it is our duty to warn the public against drawing exaggerated conclusions. The U boat was stationary It had no anti aircraft guns, and it was therefore a passive object of attack The result proves that a 163 pound bomb falling on the deck of an unoccupied and undefended U boat will sink it. It does not prove that an airplane can sink a battleship, merely it shows that a bomb of this size will work some destruction on the upper decks What a 500- or 1,000-pound bomb will do on a battleship will be proved in the tests later this month against the "Ostfriesland"

Strategical Value of Cape Cod Canal.—It has been recommended to Congress by Secretary of War Weeks that the Government purchase the Cape Cod Canal for $11,500,000 This is five million dollars less than was allowed by a Federal Court during condemnation proceedings instituted by the Government While the canal has great commercial value as providing a shorter and more sheltered route from Long Island Sound to Boston, it also is of considerable strategic value as forming part of an inside sheltered route from Boston by way of the Sound, the Raritan Canal and other inland waters to the Chesapeake. In the event of war this system of waterways would enable destroyers and other vessels of moderate draft to be transferred without risk of attack

American Maritime Policies.—In his address before the Eighth National Foreign Trade Convention, Mr James A. Farrell made the following points One, no sale at present of Government vessels to private owners, two, our steamships are well constructed and compare with the best abroad, three, the average cost approximates that of foreign ships, four, even with temporary improvements in freights it will take three years to absorb the world's idle tonnage, five, international agreement to stabilize rates and lay up tonnage might be useful, six, American traders and travelers should use American ships, seven, we should abandon the attempt to build up trade routes from every United States port and serve only ports where cargo is available, eight, Time-charter Shipping Board vessels with option of purchase, nine, operating costs must be reduced to equality with foreign costs, ten, shipping laws which impose a disadvantage estimated at five per cent on investment should be repealed

Science

News from Graham Island.—It seems only yesterday that we chronicled the sailing of the Cope Expedition, but now we have received word that a landing has been made at Graham Island. Rich seal and penguin colonies have been found

Nuisance Roots Prove Valuable—The scrub palmetto root, for years regarded as probably the most worthless product of the soil of the Gulf States and a source of heavy expense when land is being cleared for planting, is worth something after all Extensive experiments with a view to utilizing the fiber of the root for the manufacture of brushes have been successful

Restless Plymouth Rock.—For the second time in four months, Plymouth Rock has been moved On December 21, after the canopy over the rock was torn down the boulder was moved about fifty feet Three guards have watched over it night and day since To do away with these guards the rock was again moved and placed in a brick building The windows have been barred and the door securely locked Of course the end of the perambulations is not yet

University Population.—At Columbia 700 student applicants were turned away last year and the experience of all colleges and universities seems to be the same Technical education particularly has increased by leaps and bounds, for while in the period from 1880 to 1918 the general increase in university enrollment was 139 per cent the engineering schools had increased eight times as much. The great difficulty is in securing competent instruction and enough of it

Aviator Explores the Grand Canyon.—An army flier Lieut Pearson has explored the Grand Canyon with a view to studying the air currents His experiences are interesting He says 'In spite of the fact that the upper part of the Grand Canyon is thirteen miles from rim to rim and the lower gorge is eight miles wide, I felt cramped for room when I was descending into the chasm I seemed every moment to be flying right slap into some cliff'

Radio Congress.—The Radio Congress opened its sessions in Paris June 21 The purpose of the conference is to harmonize the radio rules of the world and formulate plans for bringing wireless into more general use through the encouragement of private enterprise under Government control The American Government has sent a delegation of ten of its best military and civil experts, headed by Major Gen George O Squier, Chief of the Signal Service of the United States Army Others in the party include Professors A E Kennelly of Harvard, J H Dellinger of the Bureau of Standards of the Department of Commerce, Major J A Mauborgne, for the United States Army, Admiral Magruder and Captain G R Evans, representing the American Navy, and Dr Louis Cohen

The Book of Tapa.—The interesting museum of the University of Pennsylvania is always adding something unique They have just secured one of the few copies of what is known as "The Book of Tapa" In 1787 there was published in London an interesting and curious book styled a "Catalogue" and illustrated with samples cut from specimens of the *tapa* or bark cloth collected by Captain Cook and his companions during the great explorer's three voyages. The number of specimens of cloth varies in each known copy this one has forty three specimens or four more than in the printed list in the book The work is dedicated to an unknown person, probably Warren Hastings, whose impeachment was pending when the dedication was written The *Museum Journal* contains a number of colored plates from this very interesting book

Mme. Curie Returns.—Filled with honors and weariness Mme Curie sailed on June 25th on the "Olympic" Down in that holy of holies—the specie room—was carried her precious gram of radium Special precautions had to be taken on account of the ship's instruments, for the compasses must not be disturbed in their functions. The Bureau of Standards carried out the shipping instructions. A beautiful mahogany case lined with lead and steel was provided Although the box is not large, it weighs, with these linings, 130 pounds. Directly in the center of the box are several small compartments, formed of lead and surrounded by steel, each one of the right size to admit a small glass tube containing a portion of the radium salts—the form in which the metal is handled for shipment The lid of the mahogany box is inlaid with a gold plate, handsomely marked with the following inscription "Presented by the President of the United States on behalf of the women of America to Madame Marie Sklodowska Curie in recognition of her transcendent service to science and humanity in the discovery of radium The White House, May 20, 1921"

Automobile

Farm Tractors Reduce Market for Large Engines.—With the increase in the use of farm tractors the market for large stationary farm engines—engines of 10 15 and 20 horsepower—has declined materially Formerly silo-filling for instance, required an engine of this size, but now the tractor engine usually serves the purpose The market for small farm engines on the other hand, is not appreciably affected as the farmer cannot afford to run the tractor half a mile or more every time he wants to do some corn shelling or run the lighting plant

The Closed Garage Door has brought more than one motorist to the ragged edge of profanity when returning home on a stormy night Various means have been offered to enable him to open it without leaving his car but most of these have been home made affairs of doubtful utility A device is now offered which consists of a plate inserted in the driveway in front of the door, connected with a release in such style that the passage of one wheel of the car over the plate automatically and immediately opens the door Incidentally, in the absence of a car to run over this plate the device acts as a trick lock which would puzzle a sneak thief very badly

Valve-Steel Heat Treatment—The proper heat-treatment for the valves of internal combustion engines is given in an English house organ as follows 3½ per-cent nickel steel should be normalized at 830—850 degrees centigrade No further treatment is necessary 25 per cent nickel steel should be normalized at 880—900 degrees centigrade No further treatment is necessary 13—18-per-cent tungsten valves should be heated to 950 degrees centigrade and cooled in still air, then reheated to 800 degrees centigrade and cooled in still air before machining 13 per cent chromium valves should be heated to 900 degrees centigrade and cooled in oil then reheated to 700 degrees centigrade and cooled in still air before cooling in oil

Paris Tries Six-Wheel Bus.—Experiments are now being carried out in Paris with a six wheel single deck omnibus steering through the front and the rear pair of wheels, and driving through the center pair The advantage of the new type is that an increased wheel base and additional carrying capacity are obtained with the same turning radius as for the normal two axle machine The experimental buses are being run on the Madeleine Bastille route which comprises the most crowded boulevards of the city No changes have been made in the engine, which is a four-cylinder type placed under the driver's feet the live axle is also practically the same, and the third axle is a duplicate of the front axle Suspension is by means of three pairs of semi elliptic springs

Striking Plate for Doors.—An adjustable striking plate designed to replace the old non adjustable plate or catch on automobile doors is now manufactured The old style catch is made with one or two non adjustable steps and must be fitted very carefully to the jamb of the door, so that when the door is closed it is held firmly against the rubber bumpers Any wear of the rubber bumpers, lock bolt or catch permits the door to vibrate or rattle The Franzen adjustable striking plate can be fitted after it is in position on the jamb Any wear which has a tendency to loosen the door and cause it to rattle can be compensated for by means of an accessible adjusting screw By turning the screw to the left the second movable step of the striking plate is moved in This adjustment again brings the door when closed into intimate contact with the bumper

Improved Adjustable Yoke End.—With the ordinary yoked rod ends used in brake connections it is not as easy a matter to make an adjustment of the brakes as may seem to be the case First the cotter pin has to be removed from the pin of the yoke end then the yoke pin itself must be removed, the yoke end rotated one or more half turns on the end of the rod, the yoke pin replaced and the cotter pin reinserted With a view to facilitating this operation an ingenious yoke end has been brought out An intermediate piece between the yoke end proper and the rod is provided with ears or finger pieces so that it can be readily turned without the use of tools This intermediate piece is in the form of a threaded collar which turns with comparative freedom in the hub of the yoke proper, but the tendency of vibration to work it out of adjustment is prevented by providing one head with a V shaped projection which engages with a corresponding notch in the hub of the yoke under the pressure of a coiled spring This adjustable yoke end takes the place of the adjustable yoke and turnbuckle It is claimed to be easier to assemble to adjust either by hand or wrench and to be less expensive than a separate yoke end and turnbuckle

Is It To Be Bomb or Battleship?

Elaborate Series of Tests to Determine the Effectiveness of Aircraft Against Warships

NAVAL history shows that whenever a novel and startling weapon of attack is developed, it is pretty sure to be credited with destructive power far beyond its capacity. So it was with the torpedo, the torpedo boat, the destroyer, the 'dynamite' gun and the submarine. Today in the van of this procession of cheap, quick kill-alls, proud of past accomplishment and boastful of its future conquests, is the bomb-dropping airplane.

The search for a cheap substitute for the major weapons of war is persistent, and it is perfectly natural that the smallest early successes of each should be magnified in the public mind, and that prediction should run riot as to their future performance—for is not the wish ever father to the thought?

This is all quite understandable in the layman, but that the technically-instructed officers should mount, as they so often do, into the doubtful atmosphere of prophecy, is something to give us pause. Anyone who has read the diatribes of the late Lord Fisher and of Sir Percy Scott against the battleship supplemented as it has recently been, by the testimony of our own General Mitchell and Admiral Fullom, must have wondered what had become of that fine old sense of proportion which we used to believe was a distinguishing characteristic of the men who passed through our naval and military colleges. However, the Army and Navy are now at the job of settling the question as to whether the capital ship of the future will be one that floats upon the water or one that sails through the air. We have been told that the battleship is doomed, and that the aircraft has done it. The Navy is not disturbed being perfectly satisfied, not only that the battleship has not been rendered obsolete by the airplane but that the big ship that floats upon the sea and carries the big gun was never more alive and more efficient than today and never gave such promise of holding for many years to come, its commanding position. The tests which are now under way will come pretty near to settling this much disputed question.

The first of the tests was the sinking of one of the captured German submarines. In this, as in the other experiments, the Army and Navy fliers co-operated.

The next step in the operations will be the searching by aircraft for the "Iowa" in a definite area extending from the entrance to Delaware Bay to Cape Hatteras, and with a radius of one hundred miles off shore. She will be operated under radio control from the "Ohio," several miles distant, and after the aircraft locate her she will be bombed by dummy bombs, in order to determine the extent of the ability of aircraft to register hits on a moving target. No explosives are to be dropped on the "Iowa," as she is to be used later as a moving target for the fleet's big guns.

Next will come the bombing tests, with one of the ex-German destroyers as the target. This vessel will be attacked, and, if practicable sunk by aircraft using 250-pound bombs. The other destroyers will be targets for the guns of our destroyers, as were two of the submarines.

After that will take place the bombing by the Navy and Army aircraft of the ex-German cruiser "Frankfurt," and ex-German battleship "Ostfriesland." All of the ex-German ships are eventually to be sunk, if not by bombs or gunfire, then by depth charges. They are being destroyed in conformity with the international agreement by which they were obtained.

The tests, which will be continued on through July, are for the purpose of determining the effect of gun fire and aerial bombing on the structure and material of the various vessels to be attacked as well as for tactical search exercises and tests to determine the accuracy of bombing.

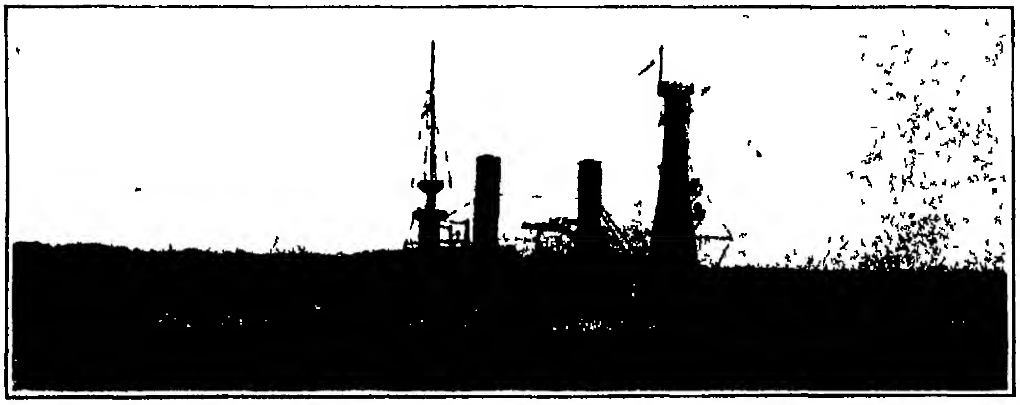
Tests will be made in a series of progressive steps. The vessel will be examined by experts after each attack is completed, and the tests will be conducted slowly so that the maximum knowledge of the effect of the explosives may be determined.

An interesting feature will be the test of communications, from aircraft to shore stations, and from aircraft to aircraft, working against radio interference, in securing a concentration of the bombing fleet over the enemy after the scouts have picked up the objective.

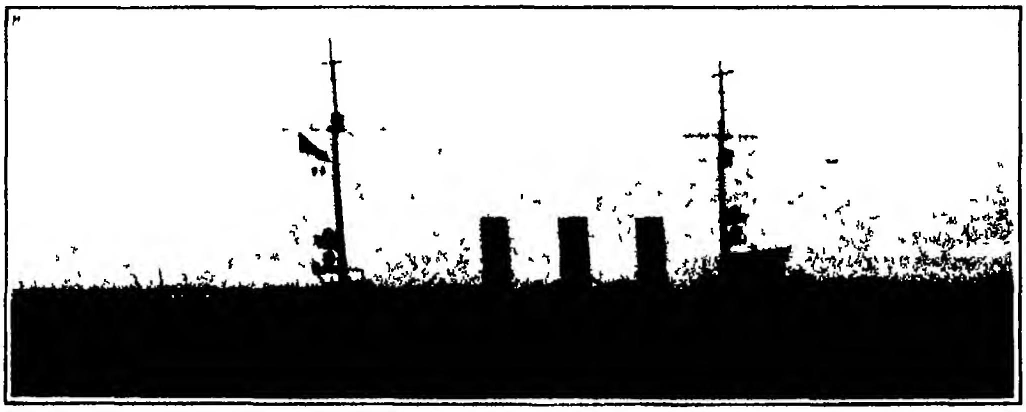
These bombing tests, according to Captain Johnson, Commander of the Atlantic Fleet Air Force, are merely a part of the day's work in the routine of the navy. They will be of no value unless they are conducted along scientific lines.

The Navy must know what effect the bombs will have and the number of hits which can be made by aircraft. It is unnecessary to drop 2,000-pound bombs on a destroyer to sink her if a 250-pound bomb will do the

Ex-German destroyer which formed the object of bomb attack by Army and Navy aviators. This is one of the surrendered German ships



Battleship "Iowa", operated by radio control from the "Ohio", several miles distant, to be attacked with dummy bombs



Ex-German cruiser "Frankfort" will first be bombed by aircraft. If not destroyed she will be sunk by big-gun fire

Battleship "Alabama," turned over to the Army, who will use her, in conjunction with the Navy, in bombing tests

work of destruction just as completely

Consequently, the air force will use small bombs on the destroyers and submarines, and will determine, after hits are made, how much damage is done and the lessons to be learned from the experiment. It will be the same in the case of the "Frankfurt" and "Ostfriesland" First, hits will be made by bombs of moderate size, the effects being registered after each hit

Then will follow attacks on the two ships, using larger bombs up to the largest, of 1,000 and 2,000 pounds, each time inspecting the ship to determine the damage done and the efficiency of the bombs themselves. The mere spectacular bombardment of the ships by a large number of bombs would serve no useful purpose, but carefully inspected results will teach the Navy certain points not entirely known respecting the efficiency of bombs and of the present methods of armor protection on the upper decks of large ships

From the foregoing, then, it will be evident that the objects of these elaborate operations are to ascertain

First, the ability of aircraft to locate vessels operating in the Coastal Zone, and to concentrate on such vessels sufficient bombing airplanes to make an effective attack.

Second, the probability of hitting, with bombs from airplanes, a vessel under way and capable of maneuvering, but incapable of anti aircraft defense

Third, the damage to vessels of comparatively recent design which will result from hits with bombs of various types and weights The vessels to be attacked by bombing are of the battleship, light cruiser, destroyer and submarine types.

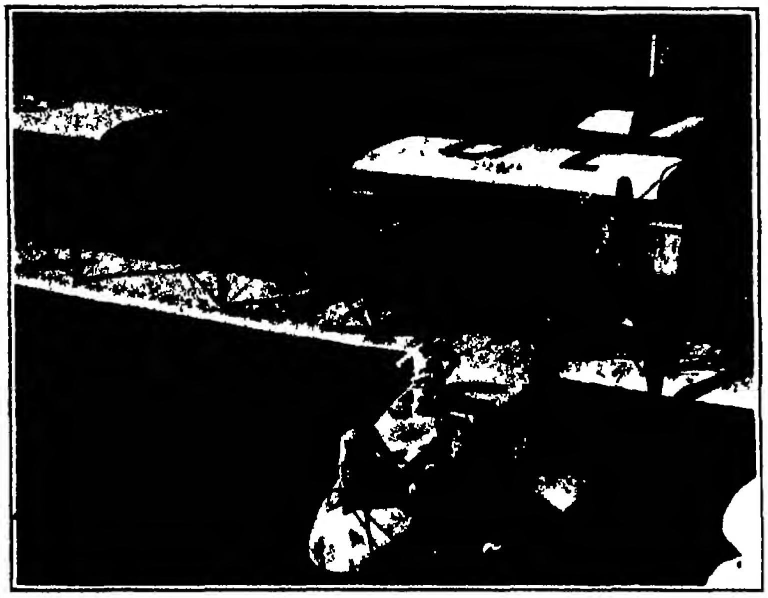
Fourth, by these experiments carried out at sea in deep water, to demonstrate the effect of an airplane bombardment of naval craft more effectively than may be done by experiments conducted with the vessels at anchor in shallow water

Fifth, it should be noted that the experiments outlined by the Navy Department do not contemplate experiments in the use of machine guns against personnel in exposed positions nor the effect of gas, incendiary and smoke bombs.

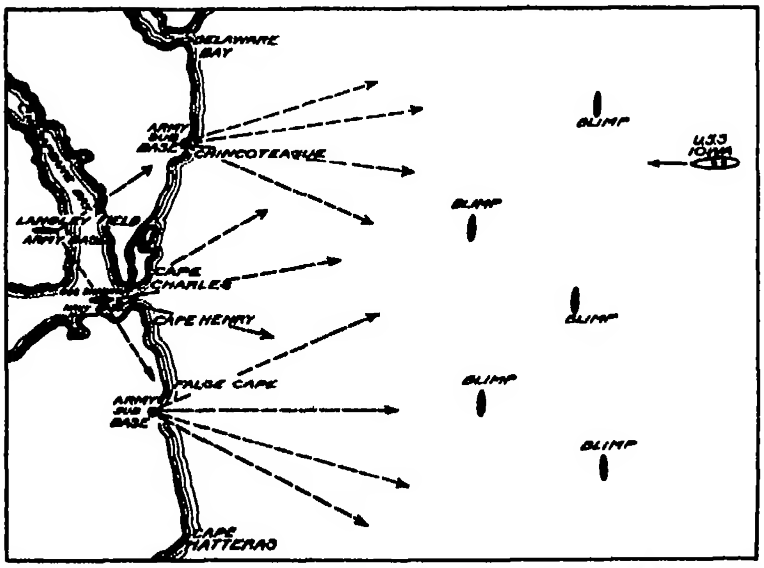
Lastly, to obtain data upon which to formulate the proper tactics to be used in attacking naval vessels by aircraft

The first of the tests, on June 21st, resulted in the sinking of the German submarine "V-117" by a 163-pound bomb dropped from a height of 1,100 feet. Six minutes after the detonation the submarine disappeared

In actual warfare an attack against a ship armed with anti aircraft guns would have to be made at an elevation of several thousand feet.



Close-up view of F-5-L being refueled from the mother ship "Shawmut", after an 1800-mile trip around the Caribbean



The plans for the bombing of the "Iowa", as she made a hostile approach to the American coast so drawn up as to simulate, as far as possible, the defensive methods which would be used in actual war In the outer zone 50 to 100 miles off shore a scouting squadron of blimps was stationed to discover the enemy and signal her position to the shore stations. Upon notification of her position and course, the aircraft concentrated for a sustained attack. Dummy bombs were used, the Navy Department wishing to reserve the ship as a target for big-gun fire at long range

Disposition of aircraft as "Iowa" approaches coast

Two planes lying astern of their mother ships, from which supplies of fuel are being piped aboard

Armstrong Radio Patent Sustained

As a result of litigation extending over a period of years, the Armstrong radio "feedback" patent has been held valid by Judge Mayer This patent covers what is probably the most important circuit arrangement in use in modern radio It made possible trans-oceanic communication and has contributed much to the art of radio telephone communication

The feedback circuit magnifies the signals received by wireless instruments thousands of times so that signals previously inaudible are now easily readable, and it further permits of very great selectivity, making possible reliable communication between two stations regardless of atmospheric conditions and of the transmission of messages by other stations.

Judge Mayer, in his opinion, says:

"This case is another contribution to the romance which has so often characterized the history of forward inventions. As a boy of 15, Armstrong became interested in radio and erected a radio station at his home In the spring of 1912 he began a close study of the fundamental action of the audion and read all the literature on the subject Sometime during this period he connected a condenser across the telephone of a simple audion receiving system and noticed that on some bulbs an increase in signal strength would result It is important, at this point to realize that Armstrong is a remarkably clear thinker His achievement was not the result of an accident but the consummation of a thoughtful and imaginative mind Step by step he proceeded with the study and experiment He was obtaining what seemed to him remarkable results and in December, 1912 he had succeeded in improving the sensitiveness of the audion by means of a new connection

The merit of the invention was soon recognized and the very apparatus of which Armstrong made the invention was subsequently utilized commercially at Sayville Long Island shortly after the outbreak of the war in 1914 to overcome difficulties in the reception of signals from Nauen Germany

The invention which by that time had become widely known was used by the Signal Corps of all the armies in the field for receiving radio messages under the difficult conditions of warfare The commercial value of the invention was appreciated at an early date and licenses were taken out by several companies during the years 1914 and 1916

All radio amateurs are familiar with the circuit It permits them to receive on a simple small antenna the radio signals transmitted from great distances. Thus it is possible for an amateur in and about New York with his antenna located on his apartment house and using the Armstrong feedback circuit to hear messages from Nauen, Honolulu, Darien, Norway, Philippine Islands, Lyons, and the great Lafayette Station installed by the Americans during the war at Bordeaux, France It is also depended upon in the delicate work of direction finding which requires receiving instruments of the utmost delicacy It was used on the NC Navy planes which crossed the Atlantic.

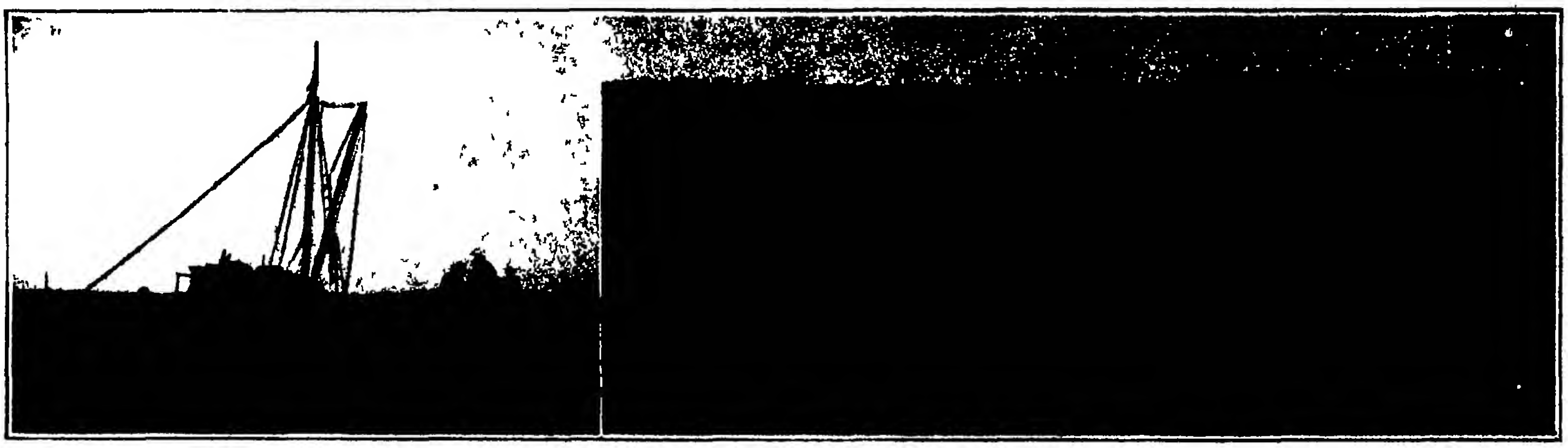
The principal defenses urged by the defendants were prior invention by De Forest and that Armstrong's invention was of a very limited character Judge Mayer held that Armstrong was the first inventor and that the invention was of a very broad character covering any feed back arrangement.

A Natural Potato Trade-Mark

An example of a curious natural trademark is found in the Red River district of Minnesota This section is famous for its Early Ohio potatoes Early Ohios do better here than anywhere else Potato growers in the Middle West have learned that seed potatoes of this variety, originating in the Red River district produce big crops and excellent quality They have learned to determine the genuineness or otherwise of Early Ohio stock claimed to be Red River by looking for certain black spots on the tubers

These black spots, the popular supposition goes, are a result of the rich black soil in which Red River Ohios are grown Seed potato buyers are well aware that Early Ohios grown in sandier soil may be brighter, cleaner, even better looking, but it matters not. They do not carry the black spot's trade-mark of the Red River product, and are rejected

The potato trade says that the Red River natural trade mark will be missing from much of the 1920 crop, and buyers will be in something of a quandary, because of particularly favorable cultural conditions last season Conditions have not been propitious for the development of the black disease spots A trade-marking agency has broken down



Left: Completing the "purse" The fish are gathered in a pocket of the net beside the boat. *Right:* Purse seiners at work on the Puget Sound salmon banks. A school of fish is being encircled by the fishermen's net in the foreground

Two stages in the catching of the sockeye salmon by means of the purse seine

Saving the Sockeye

An International Reclamation Project That Remains To Be Settled

By Robert A. Campbell

THE sockeye salmon, one of the choicest of North American food fish is facing extinction Its vast breeding grounds in the Fraser River system of British Columbia, are becoming sterile Since, following in the "finsteps" of their ancestors, the sockeye seek these spawning grounds after passing through American waters which swarm with fishermen and their appliances, the restoration of the industry to its former magnitude has become an international problem

Twenty five years ago the annual sockeye run was one of the most remarkable sights in the Puget Sound country In the fall of the year every river and small stream which mingled its fresh water with the brackish tides from the sea was alive with salmon Millions upon millions of them, rubbing their sides together, wedged solidly from bank to bank, slowly working their way up stream. Farmers of the early days drove their wagons down to the water's edge and, pitchfork in hand, loaded tons of them for use in fertilizing their fields for the next season's crop Late in the fall after the salmon had spawned, and before the floods had flushed the streams, the enormous quantities of dead fish strewn along the gravel bars sent up an odor which could be detected for miles around.

The summer of 1913 saw flood tide in the sockeye industry That year the combined American and Canadian pack was 2,401,388 cases. In 1917 the pack fell to the alarming figure of 559,702 cases. During the season of 1920 the fishing business was but a pale shadow of its former self The Pacific American fisheries, the largest concern on Puget Sound, reconstructed but six of its 15 traps. But 18 purse seiners were operating as against over 150 the year before. Formerly some 38 canneries were operating in Puget Sound waters with considerable seasonable regularity In 1920 but six of them turned a wheel, and these were run on a short shift. Three canneries on Lummi Island, representing an investment of more than a million dollars, were idle all season

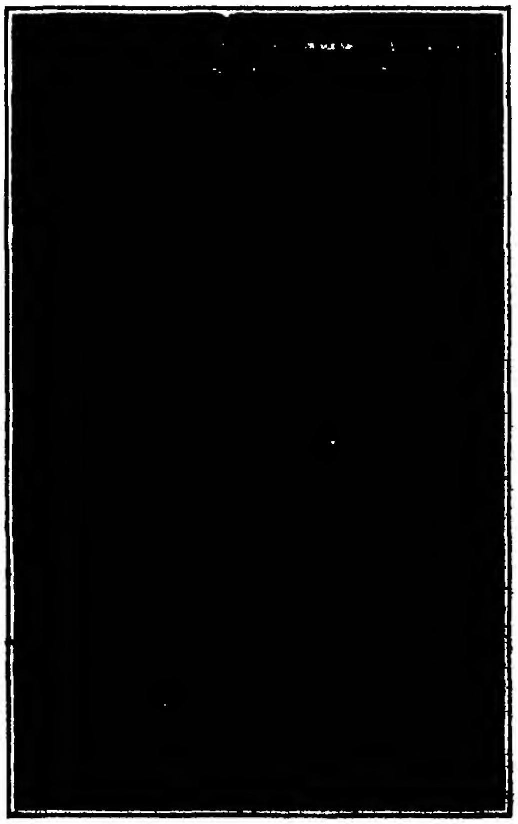
When the irresistible instinct to go back to his fresh water birth place and spawn takes possession of the sockeye in his fourth year, he appears in great schools at the entrance to the Strait of Juan de Fuca Here his battle against civilization and for reproduction sets in, for off Cape Flattery the purse seiners, tossing in their small boats, lie in wait. The shoals of fish head into the choppy strait, running the gauntlet of these small boats, until further progress is slightly barred by the San Juan Island group, thus forming the famous salmon banks.

Filtering through the narrow channels which separate these islands, the fish enter the Gulf of Georgia Now a multitude of stationary traps lie before them, placed across their accustomed route of travel, while a still greater number of purse seiners sweep the adjacent waters.

If successful in avoiding the traps and seines still another barrier confronts the sockeye. He emerges from the Gulf and drives for the mouth of the Fraser River only to find a string of gill nets across his path Stevenson, British Columbia, is the headquarters of the gill net fishermen Where the fish formerly had a stretch of water at times 85 miles wide in which to elude capture, he now finds himself in a narrow river

Various means have been adopted to snare the sockeye A purse seine is just what the name implies. This is the small man method as it does not require great capital The purse seine is a net, often 1,800 feet long, which is held perpendicularly in the water by weights at the bottom and corks which float on the surface. When not in use it is neatly arranged in folds at the stern of the boat, which carries a crew of eight men When a school of fish is encountered, one end of the net is thrown out, a parachute contrivance catches the water so that it will not follow the boat, and the latter makes a circle, paying out the web as it goes. When the circle is complete the end first thrown out is picked up and the whole thing puckered into a bag or "purse"

There is a radical difference between a purse seine and a "trap" The former goes after the fish while the latter waits for them to come In the infant days of the industry favorable trap locations—that is, shallow water near shore where the fish run in great numbers each year—were sold for snug fortunes.



A carpet of sockeye salmon on the cannery floor

A "trap" is made of piles, upon which common chicken wire is hung, and there you have it—a fish fence It is built on the principle of a funnel, although shapes vary considerably Through this funnel with a great wide mouth the fish pass into the trap proper, from which they are not wise enough to extricate themselves. It costs about $20,000 on an average to put down a trap, and it must be taken out in the fall and redriven each spring thus duplicating the cost each season

A gill net is simply a net stretched across a stream The fish drive against it and are caught by the gills, being unable to get through or back out. It can only be used in rivers carrying much silt, for the sockeye will avoid it in clear water

When the sockeye began to disappear a world of controversy arose The argument was both international and inter-method. Both Canadians and Americans sharply scrutinized the protective laws adopted by their neighbors The purse seiners blamed the trap men, the trap men blamed the purse seiners, and they both blamed the gill netters.

Out of it all came the International Commission which met in Seattle in 1918 and formulated a fishing treaty between the United States and Great Britain. The representatives of the latter were for the most part Canadians. This treaty now awaits action by the United States Senate.

Among other things the proposed treaty eliminates the alien fisherman At present Austrians predominate in the Puget Sound purse seine industry But it goes still further, and not only eliminates the alien fisherman who catches the fish, but practically makes a closed season so there will be no fish to catch. The big sockeye run comes every four years. It reaches its height during the last 10 days in July and the first 10 days in August. The proposed treaty provides a closed season from July 20 to 31, inclusive. Thus the cream of the season is cut in two. This is not so bad in the "big run" years—if there are any more such—when half the high tide period and the days before and after will supply ample fish. But in the lean years every fish counts, and one must operat continuously or not at all. A canneryman cannot afford to put down a $20,000 trap and then lose half of the best part of the season. To sum it all up, the canneries would be closed for three years and open on the fourth when the "big runs" come.

The treaty presents a great international reclamation project which can be consummated with little cost, as compared with the work of our Reclamation Service. Up to 1918 the United States Government has spent $125,000,000 in reclaiming 1,100,000 acres of arid lands, which produce an annual crop worth $80,000,000. The waters of the Fraser River basin cover an area of 1,514,000 acres, which, if seeded by spawning sockeye as abundantly as they were seeded twenty years ago, will yield an annual production of 2,000,000 cases of fish worth in the neighborhood of $30,000,000.

California's Pinon-Nut Industry

NOT five persons in a hundred who eat piñon nuts, it is safe to say, could tell what they are or where they come from, how or when they are gathered and prepared, or whether they grow on giant conifers, bushes, or vines like peanuts. The tree that bears them is a decidedly strange single-leaf sprawler known botanically as pinus monophylla It is unique among all species of this continent. It is a slow grower, not over twenty five feet high as a rule, with a short trunk, rarely straight, and a wide, rather flat crown of short, heavy, twisted and bent branches which are given off near the ground and usually hang low The bark of old trees is roughly and irregularly furrowed, nearly an inch thick, with thin, close, dark brown, sometimes reddish brown scales. The foliage generally is a pale yellow-green with a whitish, almost bluish tinge, beautiful and restful. Its odor is fragrant, pungent and refreshing The leaves are stiff, curved toward the branch, prickly, and 1¼ to 2¼ inches long. A season's leaf growth remains five to a dozen years, always bright The tree attains an age of 100 to 225 years. It blossoms one year and the stubby cones mature in autumn of the second season following By reason of alternation according to localities there is a good yield of seeds nearly every year

The range of the piñon embraces considerable western territory, beginning in Utah, Nevada and Arizona, from desert altitudes of 2,500 feet up to 10,000, and extending from Lower California to the Canadian boundary It seems to center, insofar as nuts are concerned, about the Owens Valley, on the Sierra Nevada and White Mountains—the Mt. Whitney region about 250 miles north of Los Angeles. There immense quantities of the chocolate-brown nuts are a virtual certainty every fall It is an area of approximately 5,000 square miles and one of its best parts is White Mountain Summit, where Westgard Pass, California's grand auto entrance, links east and west via the Roosevelt and Lincoln National Highways and El Camino Sierra. The tree, with roots like steel tentacles, clings to sheer granite cliffs which would appear to be pregnable only to diamond drills and blasting powder I have seen magnificent specimens haughtily perched on titanic boulders where man could not climb. It flourishes under the withering blaze of the summer sun for many months without moisture and defies such cold blasts and winter gales as high altitudes alone experience.

About Westgard Pass, on nearly a hundred thousand acres, the primitive Indian harvesters from Owens Valley operate today by the same methods employed centuries ago. Hundreds of them are on the ground. They forget all else at this time. Only the squaws toil, the bucks boss the job, sell any surplus and pocket the proceeds. The task requires five or six weeks. It is a harvest fraught with hardship, involving long journeys to and from the lofty habitat of the piñon Water always is scarce, too, but this in itself is no great deprivation to an Indian since he uses but little and that for drinking purposes only The nut and the "peaggie' are necessaries to this people of whom 1,700 remain in the valley The "peaggie' is a large, plump, greasy white worm found by the millions in the Mono Lake region It is very juicy in its fresh state but appears to be relished more when dried It looks quite as toothsome to the white man as the shrimp to the Indian, and of course no self respecting Piute would tackle a shrimp or an oyster The "peaggie" adorns giant pines much as the well known tomato worm decorates those vines It drops off at certain seasons, when it is raked up to be later converted into soup and a more or less delicate dress-

(*Continued on page 15*)

Typical pinon-nut forest of eastern California; the saw-tooth peak in the background is Mount Whitney, twenty miles away. The insert shows 2½ ounces of the nuts

The Rag-Doll Seed-Tester

THE rag doll has a purpose other than amusing the baby, its latest formation being that of divorcing the faulty ears of corn from the sound ones by germination tests The home-made equipment takes its name from the shape assumed when the corn is wrapped in bleached muslin and soaked in lukewarm water that the kernels may sprout, as a method of betraying unsound seed

The photographs describe how bleached muslin has been cut into strips 10 inches wide and from 3 to 5 feet long, and sections defined and numbered for laying kernels of corn thereon After moistening the tester the kernels, about ten in number, are placed in the different sections, care being exercised that the different samples are not mixed The outfit is so folded that the edges form company in the middle, the muslin being pressed down firmly over the corn A cob or other rounded object is used as a core around which to roll the tester, a cord or rubber band around the middle completes the formation of the doll

Dolls—that is, rag-doll seed testers—are soused in lukewarm water, taking an uninterrupted bath of from 2 to 4 hours, 10 being the maximum The testers are removed, water permitted to drain therefrom, and placed in a warm and moist atmosphere, not being subject to a temperature outside the marginal figures of 50 and 100 degrees Fahrenheit. Good and bad germinations are reflected by the samples, suggesting the discarding of faulty lots.

A New Means of Carrying Plant Disease

THE experts of the Federal Department of Agriculture have recently discovered through investigating cucumber leaf wilt an unknown method, heretofore, of plant disease carrying It is claimed that the striped cucumber beetles carry the wilt bacteria in their jaws and when they gnaw into a leaf the infection is spread In some cases the bacteria is carried over in their intestinal tract throughout a winter and in the spring are deposited so that the first time they come into contact with a broken or gnawed leaf infection is spread This is the first instance known to scientists where insects carried bacteria through an entire hibernation period to do damage in the spring

A Scientific Exposition

THE Sociedad Astronomica de España y America will celebrate the tenth anniversary of its foundation by holding a scientific exposition at Barcelona, Spain, in October, 1921 The scope of the exposition will comprise chiefly astronomy, meteorology and seismology, and the observatories, universities and other scientific centers of the world are invited to send exhibits in the shape of documents, books, photographs, old and modern instruments.

Left: Kernels in place, with one flap folded. *Center:* A number of the testers undergoing the germinating test. *Right:* A tester ready for soaking

The rag-doll seed-tester which serves to determine the germinating qualities of seed

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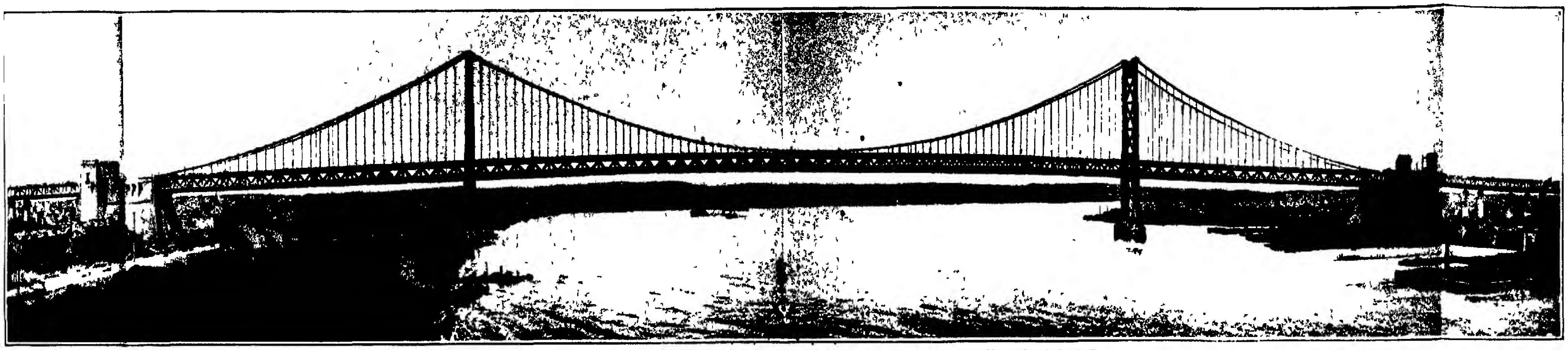
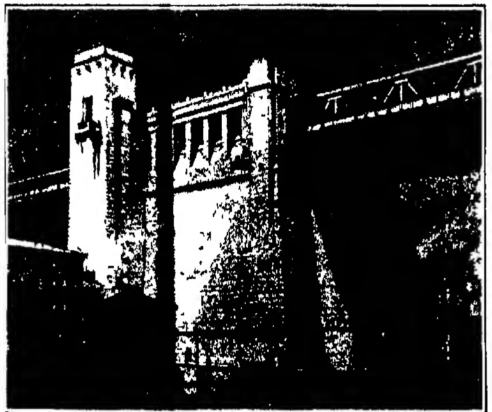
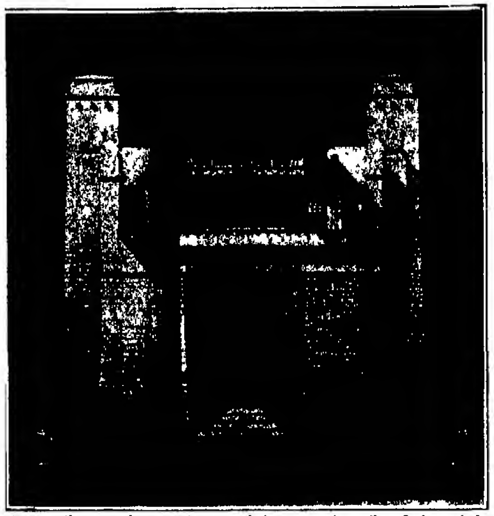


Bridge about to be constructed across the Delaware to join Camden and Philadelphia. Main span 1750 feet Two wire cables, each 30 inches in diameter



Anchorage showing buttresses, inclined in the direction of the resultant stress



Cross-section at anchorage On upper deck are two footwalks. On lower deck are two trolley tracks, 2 rapid transit tracks, and a 57-foot roadway

Bridging the Delaware at Philadelphia

A Two-Cable Suspension Bridge with a Main Span of 1750 Feet

WORK is to be started within the next few weeks by the Joint Delaware River Bridge Commission of Pennsylvania and New Jersey on a suspension bridge which will span the Delaware between Philadelphia and Camden, a distance of 1750 feet The main span will be 1,750 feet between towers with a clearance of 135 feet above high water It will be hung from two thirty inch cables each made up of 16,531 wires 0 192 of an inch in diameter, and all parts of the bridge will be designed safely to withstand a live load of 11,000 pounds per lineal foot

The main span of this bridge will be forty feet longer than that of the cantilever bridge over the Firth of Forth, and fifty feet shorter than the main span of the Quebec Bridge It will thus come third in length of main span when the bridges built or about to be built are completed First is the Hudson River Bridge 3,240 feet sec ond the Quebec Bridge 1,800 feet and third, the Philadelphia Bridge 1,750 feet About 33,000 tons of metal will be required, as compared to an estimate of 47 000 tons for a cantilever bridge over the same river The cost is estimated by the board of engi neers at $28 871 000 of which $22,470,000 covers the entire construction cost and the rest provides for the acquisition of real estate necessary for the approaches

The Board of Engineers which recom mended this bridge consists of Ralph Modjeski of Chicago, one of the world s well known bridge builders George S Web ster and Laurence A Ball Their report was submitted after six months of investi gations and surveys during which five avail able sites within limits prescribed by an act of Congress were studied and compared Their estimate of the probable cost based on existing market figures runs from ten to twenty million dollars below the rough cal culations of engineers and other experts who have made casual studies of the bridge project in Philadelphia

In their report the engineers set forth that a suspension type was selected for the reasons that it involves less risk in con struction, is $1,986,000 cheaper than the cantilever type and can be erected more quickly, saving possibly an entire season They also point out a possibility with a sus pension bridge that does not exist with the cantilever type namely, that provision may be made for increased capacity after com pletion if that is ever found necessary and also that the suspension type has less ex posed surface of metal to be kept painted, and is therefore more economical in main tenance

The engineers went to New York s four great East River bridges for a working laboratory for the study of bridge road ways and their capacity When the Manhattan Bridge was designed a single 35 foot roadway was considered wide enough for four lines of travel, two in each direction and this was placed on the center line of the structure

The Queensboro roadway which is fifty three feet two and a half inches be tween curbs, possesses great flexibility and for this reason is very popular with all drivers. It can handle almost double the traffic of a four lane roadway like that on the Manhattan Bridge Accordingly, the engineers provided for six lines of traffic on the Delaware Bridge, increasing the width for each line to nine feet six inches to care for the largest trucks, and fixing the width from curb to curb on the main structure at fifty seven feet Room also is provided for two lines of track for a bridge shuttle service, and two more for an exten sion of the city s high speed transit lines over the bridge when that facility is desired

Designs were laid out so as to have no roadway grades in excess of three and a half per cent On the transit tracks it was kept near five per cent, with a maxi mum of 5 22 per cent for a short distance into the subway connection The main piers are to be 380 feet high and 60 feet wide The total live load computation pro vides for a total of 11,000 pounds

The roadway floor was designed to carry at any point a moving load of 30 tons Concerning dead load the report says that preliminary assumption of the dead load was based on information as to the weight of similar structures A computa tion of stresses was made on this basis and the sections of the members determined Estimates of the weight of the structure were then made from these sections and the stress figures revised This procedure was repeated twice A complete check of weights, made after the design had been fully determined on did not show enough change to require any further revision in stresses Wind loading was considered to cause a pressure of fifty pounds per square foot of exposed area Temperature stresses were computed for a variation of 55 de grees above and below a normal temper ature

All main truss members towers, floor

(Continued on page 15)

Airplane view of a plaza and approach to the proposed Delaware bridge

View below one of the towers. Note the two 30 inch cables in place of the customary four cables

Animal Tissue That Does Not Die

How a Bit of Chicken Heart Has Been Kept Alive and Growing for More Than the Chick's Span of Life

By Harry A. Mount

TO help us find an answer to the vitally important questions set forth in the Editor's introductory note we have developed medicine and surgery and the allied sciences Through these we have come to a little understanding of the nature of life and of death and we have been able to reduce the number of premature deaths from accidental causes (these include diseases) But we have not been able to lengthen the maximum span of life

Those who die natural deaths that is from old age, live about the same number of years now as among the earliest of our ancestors of whom we have any record The greatest age attained by any of us is about 100 years and this only in very rare instances. In fact a thorough examination of most of the cases of this extreme old age of which we hear frequently fails to bear out the claims. It is extremely doubtful if there have been, in the past century, more than five or six persons who lived to be more than 105 years of age and it is probable that none of them lived beyond that age This statement is based upon scientific investigation

It is rather startling then, when men of unquestioned scientific standing tell us that all of the essential tissues of the body are potentially immortal and that, barring accidents, we ought never to die! This is the newest evidence the science of medicine has to offer, and it is evidence, mind you, not theory Experiments which point to this conclusion have been carried out successfully for a number of years but now we have the final proof

A skilful surgeon has been able to keep alive by artificial means, outside the animal, a bit of tissue for a longer time than the natural span of life of the animal itself The remarkable thing is that the tissue is no longer subject to the influence of time and there is no doubt that if properly cared for it will live on indefinitely—forever if you would have it so

The surgeon is Dr Alexis Carrel of the Rockefeller Institute in New York and his experiment is with a bit of connective tissue from the heart of an embryo chick, which he has kept alive and growing for more than eight years.

This experiment alone might not be conclusive, but in connection with the work of other scientists its meaning becomes clear Not only is it possible to cultivate artificially the growing life-cells of an embryo chick, but this has also been done successfully (although for shorter lengths of time) with cells from various parts of the human body, as nerve cells, muscle cells, heart muscle cells, epithelial cells from various locations in the body, kidney cells, and connective tissue cells.

"We may fairly say, I believe," says Prof. Raymond Pearl of Johns Hopkins University, Baltimore, "That the potential immortality of all the essential cellular elements of the body either has been fully demonstrated or else has been carried far enough to make the probability very great that properly conducted experiments would demonstrate the continuance of life in these cells to any definite extent" Couched in the cautious language of the scientist, the statement is none the less significant.

Perhaps it would be well to review briefly the work of some of the other experimenters before describing in detail Dr Carrel's remarkable work The idea of cultivating artificially certain cellular plants, as yeast, and some of the lowest forms of animal life, as the microscopic single-cell animals, is not new to most of us. But keeping portions of the organisms of the higher animals alive and growing was not so long ago regarded as impossible.

The idea that it might be done is due to the work of Dr Jacques Loeb, also of the Rockefeller Institute Dr Loeb was experimenting with the artificial fertilisation of frog eggs and actually succeeded in raising several specimens from eggs that had not been fertilized He became interested in the problem of why some of the eggs, which did not meet just the proper conditions, died This led him to investigate the cellular life of the frog itself and he was able to keep portions of the frog alive outside the organism for considerable periods.

Dr and Mrs. Warren H Lewis of Baltimore then made the important discovery that tissues of the chick embryo could be cultivated outside the body in pure inorganic solutions, as sodium chloride, Ringer's solution, Locke's solution, etc. No growth took place in these solutions, but the tissues could be stimulated to slow growth by the addition of calcium and potassium, maltose, dextrose, or protein decomposition products.

Other experimenters carried these results still further and it was found that nearly any animal cellular tissue could be cultivated, in much the same manner as yeast is grown, in a solution of liquids taken from the blood and tissues of the animal. But one of the experimenters, Harrison, objected properly that while the evidence pointed to the probability that these tissues could be kept alive indefinitely with proper care, the old assumption that old age and death were due to an inevitable change in the body cells would never be totally disproved until someone succeeded in keeping tissues alive beyond the natural lifetime of the animal

Dr Carrel began his experiment on January 17, 1912, when he took sixteen small fragments of the heart and blood vessels from embryo chicks seven to eight days old In March, 1912, only five of these fragments were alive In May, 1912, these had grown until over 25 cultures were alive On June 1, 1912, Dr Albert H. Ebling took charge of the cultures but due to bacterial infections many of them died and on July 1 only five survived, but these were growing actively On September 1 all were in good condition but a number of technical accidents reduced the number on September 25 to a single culture This culture was from a fragment of connective tissue derived indirectly from the fragment of a heart, "which," to quote Dr Ebling, 'still pulsated after 104 days of life *in vitro*"

On October 28, 1912, the single remaining culture began to increase rapidly in size and was divided into two parts. On November 17 there were twelve large cultures derived from these and in January, 1913, there were thirty cultures. In July, 1914, the experiment was proceeding so satisfactorily that Dr Carrel made his first public report of its progress The tissue was then 28 months old. Dr Carrel made a second report of the condition of the tissues on July 7, 1919, when the culture was over seven years old and had undergone 1,890 passages from one solution to a fresh one. The fragments of tissue are allowed to grow for 48 hours undisturbed and then divided into four parts, washed in Ringer's solution, and transplanted to fresh media. Dr. Ebling thus describes the complicated process of caring for the cultures:

"The fragments of tissue are transferred by means of a knife point to the medium (which has been spread on a microscope slide) They are imbedded thoroughly in it without folding or curling This step must be carried out rapidly to guard against imbedding after coagulation has set in, that is after fifteen or twenty seconds under ordinary conditions of room temperature and moisture. Coagulation is allowed to proceed and occurs in from 45 to 50 seconds. During this period, as well as during the period of washing in Ringer's solution, the preparations are kept under a large Petri dish in order to eliminate as nearly as possible chance bacterial contamination from the dust of the atmosphere.

"After coagulation the cover dish is inverted and placed on a hollow slide and is held in place by a small amount of vaseline. The cover dish and slide are then sealed with paraffin melted at 56 degrees centigrade and placed in an incubator kept at 39 degrees centigrade."

The medium now employed consists of equal parts of chicken plasma and chicken embryo extract. This produces a clot firm but not dense enough to interfere with migration of the cells.

The plasma is extracted from the blood of adult chickens. The chicken is first fed on a strictly regulated diet and then is given nothing to eat for a day. The carotid artery is severed and the blood drawn off into chilled paraffined tubes. The blood is then placed in a centrifugal machine and whirled at high speed, separating the solid from the fluid parts. The fluid is placed in glass tubes, sealed with paraffin and kept in cold storage until needed The chick embryo extract is made from embryos seven or eight days old. These are minced with scissors, the pulp centrifugated, and the fluid thus extracted also placed in cold storage in sealed tubes.

The area of new growth of the cultures at the end of forty-eight hours is measured by placing the slide with the culture in a projecting machine and throwing the image to a sheet of white paper It is quickly traced and the new area afterward calculated. A soft, diffused light must be used in the projector and the culture exposed as short a time as possible to avoid injury In measurements of 142 cultures it was found that the area increased from four to forty times in a period of 48 hours. Dr Ebling enumerates four conclusions from the experiment

1 A strain of connective tissue is still very active after years of life *in vitro*

2. The rate of growth of the fragments of tissue can be measured accurately and used for testing the action of many different factors contributing to the growth.

3. The rate of growth of the strain is at least as rapid as it was five years ago, if not more so.

4 The connective tissue cells appear to have the power of multiplying in a culture medium, as do micro-organisms.

The remarkable development recently brought out has been the observation that the culture is no longer subject to the influence of time. There is no apparent "aging" of the individual cells and under uniform conditions the tissue continues a uniform rate of growth. As will be observed from the early history of the culture, the progress then was erratic and uncertain. This may be blamed partially on the fact that the technique of handling the cultures had not been fully developed, but probably partially to the fact that the living cells had not become "acclimated" to their new environment. But apparently they are now quite at home and will continue to live and thrive as long as the patient scientists at Rockefeller Institute continue to care for them.

Matter of fact as it all sounds, it is a venture out into the sea of darkness, not so dramatic, but perhaps more far-reaching than the voyage of Columbus

Our bodies are potentially immortal!

All these years while we have observed old age creep up on a man and finally lay him low and have said "It is inevitable, it is the fate of all" we have been wrong. The change in cell structure which accompanies old age is not the cause of old age but a result.

The result of what? What really sets a limit to the duration of human life? Professor Pearl reasons that while we are theoretically immortals, the reason we are not actually so, is because of the very complexity of the human body. "In the body," he says, "any part is dependent for the necessities of existence, upon other parts, upon the organization of the body as a whole. If one part fails, there is failure in other parts dependent on it and the whole machine collapses. But it would appear that so long as we can prevent a breakdown of any one part, we shall continue to be young and vigorous.

What then is the span of human life? Fourscore years and ten? Actually the average is less than that. So far the probability that a man would die of disease has been so great that there was little chance of his living the maximum number of years. Considerable progress has been made in the fight on disease but we have been so busy with that fight that little has been done in a scientific way to push back the hundred-year mark which seems to have been the limit of existence.

Indeed, we have just found the basic principle upon which a successful attack on old age can be made. Perhaps the day is not so far away when most of us may reasonably anticipate a hundred years of life. And if a hundred why not a thousand?

WE are, all of us, essentially selfish creatures. No matter how intently we may be interested in our jobs, our families, our science, or our charities, we are, first of all, interested in ourselves We are interested in living our own lives and after that in the people and events about us We are interested in these in just the proportion that they affect our own lives. And the most interesting thing about life is—life itself What is life and what is death? How long ought we to live and why do we die? Can life be prolonged? It is the efforts of the Rockefeller Institute to solve these and related questions that Mr Mount describes on this page.—THE EDITOR.

The Condensing of Milk

How It Is Carried Out and Its Economic and Vital Importance to the Country

By Robert G. Skerrett

GOVERNMENT authorities have recently stated that the American people consume annually an average of 44 gallons of milk per capita. But how many of us know anything about that large industry which is devoted to treating milk so that it will keep for months or years, stand transportation to distant points, and be fit for food in any climate? The condensing of milk is a business of splendid proportions in this country.

From a modest beginning in 1856, when milk was first condensed successfully on a commercial scale, factories have gradually increased in number and amplified in their facilities until they represent today engineering developments of the highest order. Step by step the technicist has improved apparatus and processes so that the product can be turned out now of uniform quality and measuring up to standards deemed practically impossible of attainment in quantity a comparatively short span back. The significance of this is of profound interest, for as the years go on we are becoming less self-sufficient in the matter of native food supplies, and it is growing more and more vital to us that we limit waste and provide ways by which our perishable comestibles can be preserved for delayed use.

Milk, as we have been told time and again latterly, is a so-called "complete food," peculiarly suited to the nourishing of the young, invalids, and persons of advanced age. But it is equally true that every one of us would be the better off physically if we saw to it that milk entered more generously into our daily dietary. It is especially qualified to furnish nutritive factors perhaps lacking in other edibles which frequently predominate in the average fare—in short, milk can do much to insure the balanced ration essential to bodily well being.

While nationally viewed, each of us may seem to have at his disposal annually an allowance of 44 gallons of milk, there are many thousands of our fellow citizens that are not so favored. This is noticeably the case in the Southern States, where the natives eat much less of animal foods, such as milk and lean meats, than do others of us who are the beneficiaries of different agricultural conditions. For this reason as has been brought to light of late, pellagra, a disease of malnutrition, is one of the foremost causes of death in the South, and recent figures disclose that fully 125,000 persons are afflicted with it in the course of a twelvemonth. The U. S. Public Health Service has not hesitated to say that "Milk is the most important single food in balancing the diet and in preventing or curing pellagra." While the dwellers in that widespread region cannot get fresh milk or enough of it, still, happily, canned milk can be supplied them in plenty. But enough upon the physiological and therapeutic virtues of this topic, for the purpose of this article is to point out the economic aspect of the condensed milk industry and what it stands for in the realm of true conservation.

Thirty years ago the total production of condensed milk here was substantially 37,927,000 pounds, valued at $3,587,000. In 1900, the condenseries turned out 186,922,000 pounds worth at that time $11,889,000. Nine years later the production reached 494,797,000 pounds, quoted at $33,563,000. In 1919 the 240 plants engaged in the business put up 2,030,958,000 pounds of condensed milk of different kinds, which had a market value of approximately $200,000,000. During the decade from 1909 to 1919 the volume of the production increased 410 per cent. This expansion can be properly attributed to the popular recognition of the character of the commodity obtained through the employment of scientific and typically up-to-date processes. And that we may understand the methods used, let us sketch the procedure in vogue at one of the most modern of condenseries.

After passing the rigid inspection at the receiving room, the raw milk is weighed and then discharged into a large storage vat or enamel lined tank equipped with power-operated paddles which keep the milk in motion so that the cream cannot separate from the mass and rise to the surface. The storage tank is generally supplemented by a number of containers—all of them cooled by water jackets—and in these the milk is continually agitated or stirred by rotating sweeps.

Next, the raw milk is fed into what are termed hot wells, deep, open, iron vessels where the fluid is heated sufficiently to kill all contained harmful bacteria, etc. The hot wells are only partly filled, but, when the temperature has been raised to the point desired, the milk expands rapidly and rises in a foamy mass to the top of the containers. When this stage is reached the steam is turned off. About 2,000 pounds of milk are handled at a single heating. Now comes the condensing.

This concentration is effected in large copper vacuum pans or kettles, each of which is capable of treating 100,000 pounds of fluid milk daily. The purpose of the vacuum pans is to promote the rapid evaporation of much of the water content and to achieve this without recourse to a temperature that will cook the milk the while. If the milk were subjected to a temperature of 214 degrees—its boiling point—it would acquire a flavor which is objectionable to many people therefore vaporizing must take place well below this. A vacuum of about 28 inches occasions ebullition somewhere around 100 degrees Fahrenheit. Interposed between a powerful vacuum pump and the dome of the vacuum pan is a water jacketed condenser, and as the steam is drawn off by the suction the condenser deals with it. Gradually, the milk thickens as the steam coils in the pan promote evaporation, and when successive tests show that the density has reached the prescribed point the process is halted, and the condensed milk is drained off. It takes about two hours to effect the concentration.

Leaving the vacuum pans, the milk is put through a special apparatus called a homogenizer. This

(*Continued on page 16*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The High Cost of Flying

To the Editor of the SCIENTIFIC AMERICAN:

Here's something you probably didn't know. I quote from a San Francisco paper, which explains why Japan has barred all platinum exports by telling the applications of this metal. "Its essentiality to war activities is seen in the fact that platinum is the only metal that will stand the intense friction of the contact points in airplane engines. All bearings are coated with it."

It would appear that the flivver of the skies is a long way off. Or perhaps Mr. Ford will evolve some process for substituting gold and silver for platinum in airplane bearings, and thereby bring these craft within the reach of all.

San Francisco. C. E. RANDALL.

Wages vs. Prices

To the Editor of the SCIENTIFIC AMERICAN:

Apropos to the series of articles you have had on the labor question, I suggest the following for your consideration.

That the Federal Government appoint a permanent board having the confidence of the laboring classes, whose function shall be to fix the relative scale of wages and the working conditions covering the labor employed in the various industries of the country. The rate of wages shall be based upon the labor, skill, and danger involved in the occupation. Once the rate is determined it should become the law of the land, equally binding upon employer and employee with adequate penalties to insure its enforcement.

This body, at its first meeting, naturally, will not evolve a perfect schedule, but through its power of investigation, and by studying the drift of labor, it will eventually determine a schedule which will be approximately just. At its worst, and in the very beginning, the results obtained will be far better than the results obtained under the present system where the wages paid are determined by the relative power of the employers and the employees of an industry, and the position of that industry, with little regard to the actual comparative value of the work performed.

The principle underlying the above suggestion is, that each man should be able to buy back from the common fund of wealth produced that part which he has contributed to it and therefore its determination right fully belongs to society and not to any individual or group of individuals.

The results of the above would be:

1. To reduce the present antagonism between capital and labor.
2. To prevent strikes, for, as the determination of the rate of wages will not lie with the employers, it is hardly conceivable that any body of men will strike against society.
3. To put every industry and every investor, irrespective of location, on the same competitive basis with regard to its labor.
4. To prevent excessive rise in price based upon claims that wages have been advanced, or labor was inefficient, as has been the case last year.
5. To obviate the necessity of delegates with their abuse of power, also the existence of dishonest labor leaders and employers.
6. To do away with child labor and women labor under certain undesirable conditions.
7. To maintain the rate of wages at a time as at present, where it is absolutely necessary that the purchasing power of the country be maintained in order to preserve old values and restore confidence.
8. To prevent depression, for, with wages standardized, commercial loans will show if merchandise is going into consumption or accumulating on the market.

New York. JEROME LEVY.

The Cost of Multiple-Arch Dams

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of February 5, 1921, page 108, appears an article by J. F. Springer, describing some of my work. As the designer of this type of dam, and the builder of 14 as well as designer of about 20 more under contract and prospect, it is to my interest that the descriptions of this work be accurate. Of course, many expressions and statements of a non-technical writer who writes of technical things must be overlooked, for they are apt to have statements made to them by the ill informed that they are not in a position to refute or to correct. It would seem to bear out the statement of doubt as to the economics of this type of dam when we read in his article that the cost of the Lake Hodges Dam, "exclusive of accessories," is $4,000,000. It is an error that I should be permitted to correct through your paper, for as a fact the actual overall cost of this dam to the company was, "*inclusive* of all accessories," $302,212, which is a far cry from *four millions*.

The San Dieguito Dam cost but 78 per cent of the lowest bid for a plain earth fill. The Murray Dam which is fairly well described, cost $124,454 overall, and as it is 900 feet long and 117 feet high, it is surely a record for economy of cost.

The remarkable scientific features of these dams will be very interesting reading to the scientific world, not only the economics, but the features of their design.

JOHN S. EASTWOOD.

Oakland, Cal.

Mr. Love's Cycle-Car

To the Editor of the SCIENTIFIC AMERICAN:

Your article on the "Vest-pocket Automobile" in the issue of April 30th includes some remarks based on a communication I made you some time ago with reference to an illustration appearing at that time. This illustration purported to be "a home-made flivver," and if you refer to my original communication you will find that I was of the opinion that it was really a "Tamplin" cycle-car with "roller-blinds, chip-carving and other home-made improvements." In proof of which opinion I sent you a photograph of the "Tamplin" I purchased last spring, which photograph you reproduce now with accompanying letter-press which might make the reader infer that it was a "V. P. A." reconstructed by me from something else. I must apologise if my bad American has been responsible for the misunderstanding and I should be glad if you can publish this letter as your circulation in Great Britain is doubtless large enough to make your article as it stands against the best interests of the makers of the vehicle in question with whom I have no other relation than as a very satisfied customer.

Lee, England. ANGUS LOVE.

The Heavens for July, 1921

What a Study of Atoms aud Electrons Tells Us of the Stars

By Henry Norris Russell, Ph D.

IT is becoming more and more evident, as both sciences advance that the astronomy of the future will be intimately associated with and dependent upon the concepts and the results of physics, and especially of that branch of physics which deals with the constitution and properties of atoms Our knowledge within the latter field has been very greatly extended within the last decade, and many astronomical observations which before were puzzling have thereby been explained

This is particularly true in the realm of spectroscopy The main facts regarding the emission of light by hot bodies, and by hot gases in particular have been known for many years but it is only recently that we have even begun to have an idea of the processes taking place inside the atoms of the gas, which are involved

For example when the vapor of a given element, such as calcium or iron, is confined in a heated tube or "furnace" and observed through the end of the tube, the spectrum of the light which it emits shows certain bright lines If the temperature is raised these lines grow stronger and new lines appear in addition When the same metal is brought into an electric arc (which is hotter, and also subject to direct electrical action), more lines appear while a yet more advanced stage may be reached by passing a powerful spark, fed by a source of current of high tension, between two bits of the metal and in the spectrum from this lines may be found which were not to be observed at any of the lower stages of temperature

Extensive studies have been made of these phenomena and long lists of "furnace" and "spark" lines compiled, with important astronomical applications But the physical explanation, from the atomic standpoint, lagged behind, and came only with the application of the modern quantum theory, which has been remarkably successful

Why Are the Spectral Lines?

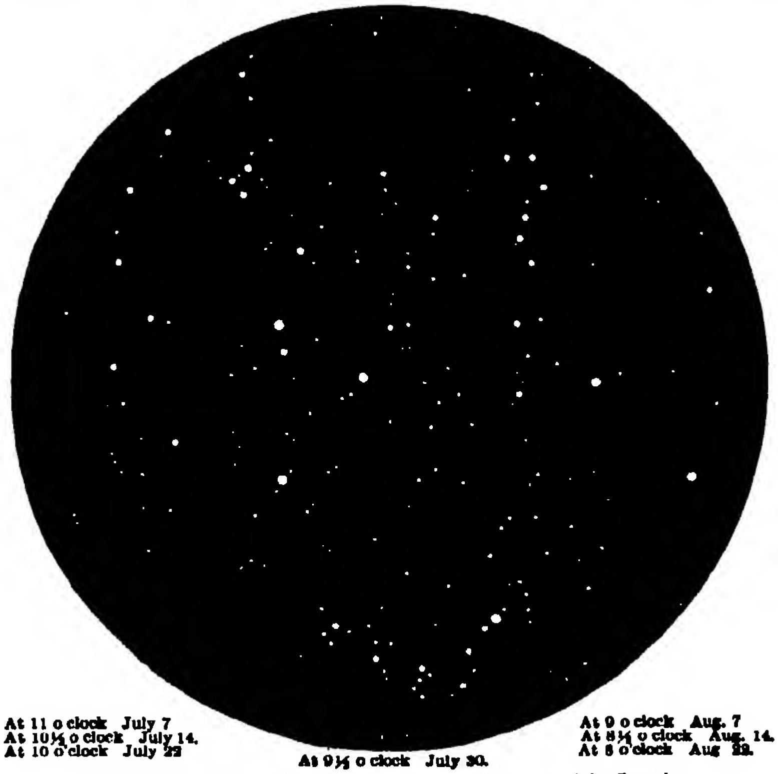
We have good reason to believe that an atom of any element consists of a central, and very small, nucleus, carrying a positive electrical charge, surrounded by a number of negatively charged electrons, which under the system of forces acting between them and the nucleus arrange themselves automatically in a definite pattern, probably consisting of several concentric shells or layers, at least in the heavier atoms. In the hydrogen atom there is but one electron, in helium two, in oxygen eight, in sodium eleven, in iron twenty six, and so on up to 82 for lead and 92 for uranium The inner electrons are held by very powerful forces and are hard to dislodge, but a few of the outer most are relatively easy to displace and it is these which are concerned in the chemical affinity between atoms of different sorts, and also in the production of the radiation of the visible spectrum To pull one of these electrons away from the rest of the atom, or as it is called to ionize the atom, demands a certain expenditure of energy, and this produces an absorption of light by the gas of which this atom is a part When some other free electron comes near to the ionized atom, it will be attracted to it (provided it does not go by too fast), and, in falling back, a corresponding amount of energy will be emitted in the form of light radiated by the gas.

Recent research has shown that this is but part of the story There appear to be many different positions in which the electron can stop, short of being pulled clear away from the atom. The farther out it gets the more energy is required to raise it—the greatest amount of all corresponding to the complete removal of the electron, or the ionization of the atom.

Now when an electron changes from one of these states to another light is absorbed, if it is pulled up to a "higher level nearer the outside of the atom, or emitted if it drops to a 'lower level", and this light consists of vibrations at a perfectly definite rate, giving a sharp line in the spectrum. The most remarkable feature remains to be mentioned. The number of light vibrations per second is exactly proportional to the amount of energy which is required to pull the electron up from one position to the other, or is liberated when it comes back. The reason for this famous quantum relation"—and indeed the reason why the various possible positions for the electron should exist at all—remains still a mystery which is regarded by the ablest physicists as one of the hardest problems of science But the fact has been tested in so many ways that no doubt remains

When the spectra of the elements are studied from this standpoint it is found that the furnace lines correspond (in the case of absorption) to the raising of the electron from the very lowest 'level at which it normally is situated in the undisturbed atom to various higher levels while the arc lines, in general, correspond to the raising of the electron from one of these higher levels to another When light is emitted we have to do with an electron falling back over one of the same intervals

The enhanced lines correspond to still another process After one electron has been taken clear out of the



At 11 o clock July 7
At 10½ o clock July 14.
At 10 o'clock July 22

At 9½ o clock July 30.

At 9 o clock Aug. 7
At 8½ o clock Aug. 14.
At 8 o'clock Aug 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later 12 o clock on July 7 etc.

NIGHT SKY: JULY AND AUGUST

atom, it is often possible, by a greater force, to pull a second electron out, and doubly ionize the atom In this process too there are various possible "levels" between which the second electron may shift, and a corresponding set of lines, all quite different from the furnace or arc lines. It is even possible that an atom may lose a third or actually a fourth electron, and there is reason to suppose that some spectral lines, produced only in very violent sparks, are of this origin.

What It Means to the Astronomer

With these ideas in mind it is very easy to see why the furnace lines are characteristic of the red stars, like Betelguese, the arc lines of yellow stars, like the sun, and the spark lines of very white stars, like Sirius. In the hot atmospheres of the stars, the atoms collide and jostle one another The red stars are the coolest, and the collisions are the least violent, so that most of the atoms are in their undisturbed condition, and absorb only the flame lines. In the hotter atmosphere of the sun many of the atoms are jostled so that the electrons within them are raised to higher "levels" and are in a position to be raised further, with absorption of the arc lines. Finally, in the still hotter white stars most of the atoms are completely ionized, and are therefore ready to have a second electron removed, with absorption of the light corresponding to the spark lines For some elements, such as calcium, this process occurs with relative ease, hence the spark lines of calcium—the great H and K lines in the violet—appear strongly in the sun Helium on the other hand is the most difficult of all the elements to ionize, and the amount of energy required even to lift an electron from the lowest "level" to the next above is so great that the corresponding light vibrations are exceedingly rapid, and lie so far in the ultra violet that all ordinarily transparent substances are opaque for them The visible lines of helium correspond to a lifting of an electron from the second, or even a higher level to one still above, and can only be produced in an atom which has already been violently jostled, so as to throw the electron up to the second "level." This explains why the absorption lines of helium are found only in the very hot stars, like those in Orion Spark lines of helium, corresponding to the loss of a second electron, are known, but these are found only in a very few stars which, from other evidence as well, we have reason to believe to be the hottest in the heavens.

Many beautiful applications of this theory have recently been worked out by an Indian physicist, Dr Megh Nad Saha, of the University of Calcutta Much of the foregoing discussion is adapted from his work, and one more instance of it may be given. The dark lines of sodium are strong in the solar spectrum Those of potassium are present, but weak The rare alkali metals, rubidium and caesium, show many strong lines but these do not appear in the sun at all This has long been a puzzle, but Dr Saha has given the solution

Laboratory experiments have shown that it is fairly easy to remove an electron from a sodium atom easier to get one out of a potassium atom, and still easier for rubidium and caesium To get a second electron away from any of these atoms, after the first is gone, is however very difficult. Calculation shows that, in the sun's atmosphere, sodium vapor should be largely ionized, with however a considerable percentage remaining un-ionized atoms, which still retain one electron that may be removed by the action of light, with absorption of the well known sodium lines. For potassium, almost all the atoms are ionized, leaving very few in a position to produce the absorption lines Rubidium and caesium, still easier to ionize, would be completely ionized, leaving no atoms at all in a position to produce the absorption lines which are so conspicuous under the less extreme conditions of our laboratories. Hence the weakness of the potassium lines, and the absence of those of the other elements, is completely explained

When more laboratory work has been done (largely by electrical methods) on those matters, it probably will be possible to calculate with fair precision the temperatures of the atmospheres of the various types of stars, simply from a knowledge of the degree to which the various sorts of atoms in them are ionized, as indicated by the lines in their spectra

The Heavens

At our hour of observation Vega is almost overhead Cygnus is high in the east, and Aquila in the southeast, a little lower Below it lie Capricornus and Aquarius, and to the right, due south, is Sagittarius, with Scorpio to the west of it, and Ophiuchus above the latter Bootes is the most conspicuous western constellation, with Corona above it and Hercules almost overhead. Ursa Major is in the northwest, Ursa Minor and Draco in the north, Cassiopeia and Cepheus in the northeast, and Pegasus has just risen in the east

The Planets

Mercury is an evening star at the beginning of the

(*Continued on page 16*)

A Rocking Stone from Buenos Aires

THOSE who are familiar with the sights of Bronx Park, New York, know what a rocking stone is. For others, it may be explained that the term refers to a boulder of decent size that has been deposited, usually by glacial action, on the surface of rocky ground in such a way as to sway back and forth under the application of pressure from the wind or from a human hand, without toppling completely over. The phenomenon must obviously be a rare one, since the stone must possess sufficiently stable equilibrium to prevent it from keeling over entirely, yet be unstable enough to make motion possible. The Bronx rocking stone is an unusually heavy one, standing well above the head of the person who would rock it. And now we learn of a similar rock down in the southern hemisphere, near Buenos Aires. In at least one respect this is more extraordinary than the New York stone, for the latter presents an entirely solid picture to the eye, and one would never suppose that it would rock until one had tried it, but the Argentine boulder looks as though the merest breath would topple it over into the valley below. This rocking stone is no small stone with regard to size, either, it is 24 feet high and 18 feet long, and is estimated to weigh somewhat more than 800 tons.

An unusually large rocking stone in the Argentine

Berlin's Forthcoming Skyscraper

WE have had it sufficiently impressed upon us that England and France are putting American ideas into operation in the manufacture of factory made goods—the quantity-production methods of Mr. Ford and others like him are really taking hold on the other side of the ocean. Now it appears that even the Germans have filched a leaf out of Uncle Samuel's book and that as a result the continent is going to see its first "cloud-scraper" as the German translation has it. The architect of Berlin in an effort to follow our lead is right up to the minute, too, and has stepped back his upper stories from his lower ones, exactly after the fashion made necessary by New York's new building laws, which restrict the height to which one may build over his entire plot while leaving him with more freedom over a part thereof. But he has gone us one better in the character of the lower block of his building, which as shown in the accompanying architect's drawing, is to be circular. We do not know how this structure will be received in Berlin or how it will look in its low flung environs, but to our own eye, jaded by long contact with New York's two sky-lines and her numerous street canyons this curious shape makes a distinct appeal.

The architect's drawing for the front elevation of the first Continental skyscraper, about to go up in Berlin

New German Process of Preparing Flour

GERMAN traffic conditions are in such a bad state that the sending of grain for long distances to be ground in large mills is at present out of the question. Under these circumstances the grain must be both stored and ground in the locality where it is produced. One advantage of this method is that the grain can be stored without bags and can, therefore, be more conveniently handled, then, too, grain keeps much better than flour. A new system of producing flour adapted for use in small local mills has recently been devised in Germany, this is known as the Steinmetz system for cleaning and grinding grain. Instead of being ground when entirely dry as in the ordinary process, the grain is literally skinned in a moist condition, just as the skin is peeled off an almond when blanched.

This skin of a kernel of grain consists exteriorly of a permeable layer of ligneous fiber intended as an external means of mechanical protection and an inner integument which is impervious to water and is meant to keep the internal portion of the grain in a dry condition.

After this sort of intensive peeling and cleaning of the grain, it can be ground in a much simpler manner than when, as is the case in ordinary grinding, special care must be taken to keep the pure flour itself as free as possible from the imperfectly cleaned particles of the outer hull. The Steinmetz system employs for grinding vertical machines of the simplest type of construction. In this patented device the flour is hurled by means of the centrifugal force of the grindstone itself against the surrounding system of sieves, so that elaborate sifting machines become unnecessary. However, where such machines are already possessed there is no need of removing them since they can be applied after the preliminary system of cleaning.

Contrary to the so-called whole-wheat system which accomplishes the production of the so-called whole-wheat flour, the Steinmetz system merely produces dark grades and light grades of flour like ordinary mills.

The Steinmetz system also includes a special process of baking, which in consequence of a new sort of construction of the baking forms, succeeds in accomplishing the always desirable slow baking of the dough. In consequence of the fact that the dough in this process is comparatively soft, the finished loaves have the best degree of lightness, it being easier to raise a soft dough than a stiff dough.

The entire process of cleansing and grinding the grain requires only five minutes, so that it is possible to have bread ready for consumption in three hours from the reaping of the grain. The bread has a peculiarly agreeable and "clean" taste because of the absence of the foreign bacteria.

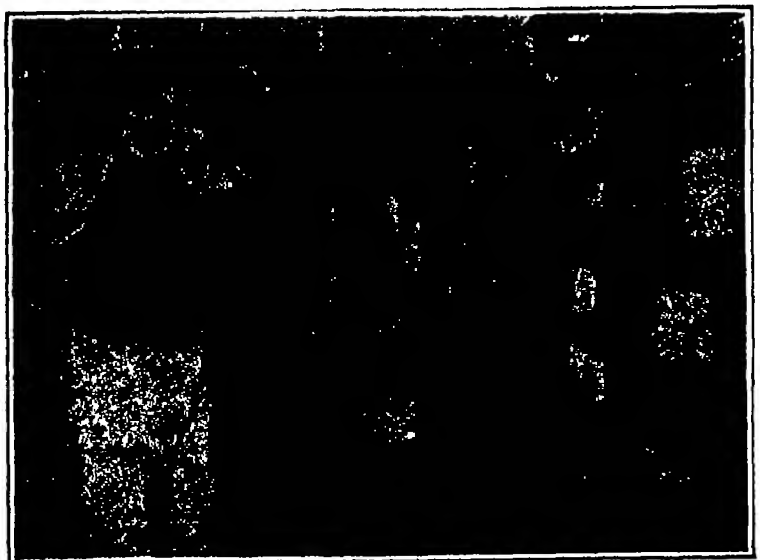
The baking forms or "pans" are made of clay with leaden bottoms which allow free access of heat to the dough, thus baking it thoroughly in the interior as well as upon the outside of the loaf.

American-made Swiss cheese, a la U. S. Government Laboratory

European Cheese Made in America

THERE is a joke, hoary with age about the man who holds the responsible job of punching the holes in the Swiss cheeses. One of the illustrations herewith would indicate that there is about as much truth as fiction in this jest. The fact is, the experts of the Department of Agriculture, in their close investigation of the science of cheese-making with a view to making New York and Wisconsin, rather than Edam and Roquefort, the sources of American cheese supply, have learned a lot about cheeses, and incidentally a good deal about the holes therein. It seems that the holes, whether they appear in the finished product or not, are quite necessary during the intermediate stages of cheese formation, in order to permit of the proper circulation of air through the mass and the proper growth of the mold. Before the cheese is ripe the holes close up, but their work has been done.

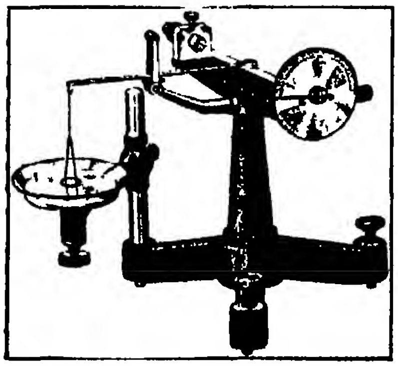
The process in connection with which the particular punch which we illustrate is used is one for making first-class Roquefort cheese from cow's milk. It was always supposed that goat's milk was necessary for this, and it was believed that the proper conditions for the ripening of the cheeses were to be found only in certain caves of the district after which these cheeses take their name. But Uncle Sam's inquisitive chemists have learned by long investigation and repeated experiment that they can start with cow's milk, attain the desired conditions of temperature, moisture and air circulation for the curing process, and come out at the end with just as good Roquefort as ever carried a customs label.



Not a jig for transmission covers, merely the machine that punches the holes in the Roquefort cheese made by Department of Agriculture investigators

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



This instrument determines the surface tension of any liquid and gives a direct reading on the dial

Testing the Surface Tension of Liquids

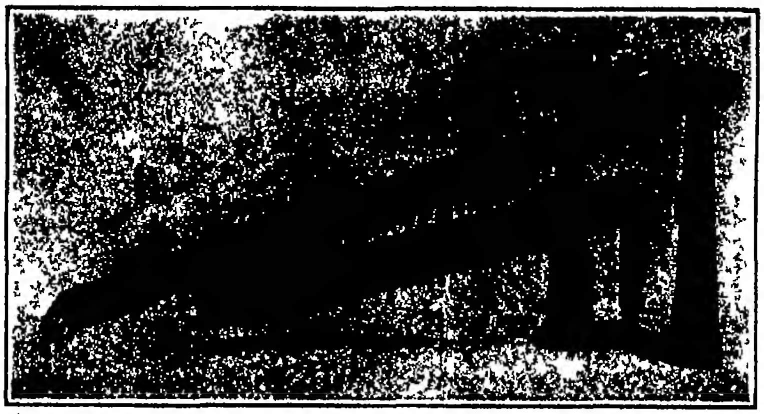
AN apparatus for measuring the surface tension or variation of surface tensions of a given liquid has been perfected by a Chicago manufacturer The device is in reality a torsion balance and the torsion of the wire is used to counteract the tension of the liquid film and to break it A single reading on a dial indicating the degree of torsion of the wire gives a figure which if the instrument has previously been standardised with water, gives the surface tension of the liquid by a simple proportion

The instrument consists of a stand provided at the top with a fine steel wire stretched between end supports One end of the wire is tightly clamped while the other is attached to a worm wheel controlled by a thumb screw To the worm wheel is attached a pointer which moves over a metal scale graduated in degrees. A hollow light aluminum lever with a small hook in the outer end is clamped to the middle of the wire. A stirrup is attached to the hook and carries a loop with a periphery of 4 centimeters in length After placing this loop in contact with the liquid the pointer is set at zero and the torsion of the wire is gradually increased by the thumb screw till the loop of wire tears loose from the liquid

The action of surface tension in biological phenomena is a very important study

The Solid Tone-Arm

THOSE who believe that the ultimate phonograph will be on some principle differing from that found in the conventional hollow metal tone-arm will be interested in the experiments conducted during the past eighteen years by Mr C B Repp of Plainfield, N J Mr Repp conveys the tone vibrations through solid wood and string, eliminating the harsh metallic tone from instrumental music and the nasal twang from vocal pieces He has constructed, of wood similar to that used in violins and aged by a special process, a solid tone-arm which he employs to carry the vibrations to a stationary sound box The wood arm is connected to the center of the disk in the sound box by a linen string The solid wood arm uses the conventional steel needle, but allows this to rest at an unusually low angle, which it is claimed permits an easier drag of the needle over the face of the record than is possible with the ordinary arrangement. This not alone is believed to lengthen the life of the record, but is stated also to reduce the surface noise.

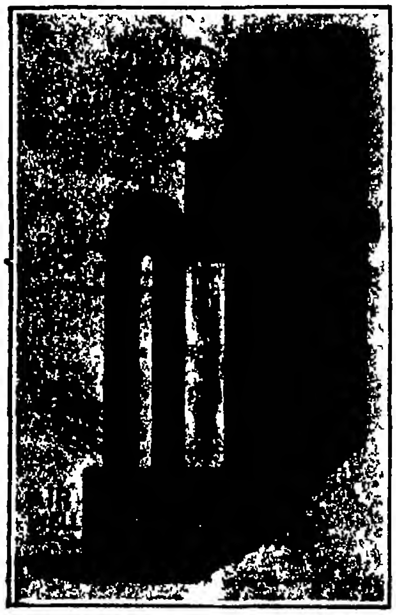


Tone-arm of solid wood, hooked to the center of the diaphragm by a linen string

A Partnership of Ventilator and Radiator

TO Commander J E. Palmer, U S.N., goes the credit for having invented what appears to be an ingenious system of ventilating and heating that is applicable wherever radiators are in use Referring to the accompanying drawing, it will be noted that his system consists simply of a box arrangement at a partly open window to conduct the fresh air down behind a radiator where it becomes heated and thence dissipated into the room so that a person can sit close to the window without feeling the slightest draft

The advantages of this system are said to be manifold. First, it is simple, secondly, it is automatic, requiring no attention other than raising or lowering the window so as to regulate the amount of air, third, it costs little to build. The operation is due to the outside air being cold and heavy, thus forcing itself through the open window and against the warm air of less density in the room. Its weight causes it to drop down behind the radiator, as indicated by the arrows. Once heated the fresh air rises out of the air well and is distributed throughout the room. This system was used most successfully for a whole winter in an office in the Navy Yard at Portsmouth, N H., where the outside temperature was at times as low as 25 deg. below zero.



A patented system of drawing in outside air and warming it for ventilating purposes

An Out-of-the-Ordinary Use for Discarded Tires

THE latest novel use for discarded automobile tires to come to our attention is for small buoys. An aircraft company has been making buoys of the type shown in the accompanying illustration, in the construction of which a discarded automobile tire plays an important part. The tire, it will be noted, is placed about the main body of the buoy, to keep it afloat, thereby replacing the cork filling or other means generally employed to keep buoys above water The automobile tire buoys are used for anchoring seaplanes and flying boats.

A discarded automobile tire used as a ring about a buoy to give it greater buoyancy

Advantages of Motor Crane

MANNED by a crew of three, an automobile crane consisting of a large crane mounted on a large chain driven truck chassis is capable of setting more telegraph or trolley poles than could be set by three gangs of men dependent on hand methods. Similar economies over manual operations are realised by using the motor crane equipped with a clamshell bucket for unloading bulk material from freight car to pile or from car to truck Also on excavating jobs, which are not of sufficient magnitude to warrant the moving of a large and cumbersome steam shovel, this portable crane proves its worth. The crane itself follows the usual lines. It is of the full-swing, self-contained type, rotating through 360 degrees, and is driven by a separate, 4-cylinder gasoline motor which is built with an extra large flywheel so as to run smoothly in spite of sudden application and release of loads. The capacity of the crane is 8,000 lbs.

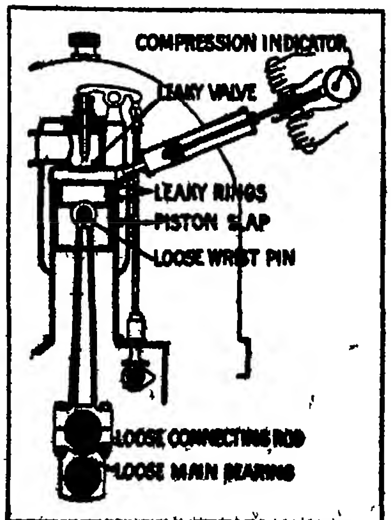
The particular advantage of this crane unit is its ability to move rapidly from place to place. This makes it especially adaptable for operations which must be undertaken quickly or for work of short duration where more time would be spent in transporting the customary steam-driven or crawler type to the site than in doing the work after arrival. Some of the special uses to which equipment of this type may be put are: Clearing streets of wreckage resulting from fire or collisions, handling trolley rails, and setting up heavy pieces of machinery.

A Device for Locating Automobile Engine Troubles

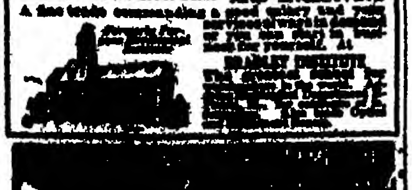
SIXTEEN years' experience in automobile repairs has led E. A. Hammett of Kansas City, Mo., to invent a motor testing device, which, so he claims, locates loose wrist pins, piston slap, connecting rod and main bearing knocks, leaky valves and leaky piston rings, when the motor is not running and without taking the motor to pieces.

When the motor is running there are two distinct things taking place, namely, an explosion for power, and a vacuum for taking in another charge. Between these two effects we get our knocks. When the motor is in a firing position, but not running, the motor tester invented by Mr Hammett is used to create alternately a vacuum and a compression in the firing chamber through the spark plug opening, which serves to indicate knocks and leaks in the motor Each cylinder is tested separately, consequently the operator knows where and what the trouble is.

The accompanying sketch shows how the tester is used Connection to the cylinder is made by screwing into the spark plug hole. To test compression, the tester handle is pushed down and the motor is turned two complete revolutions by hand. The gage then indicates the number of pounds compression in the cylinder Other adjustments are made for testing for other troubles.



A simple device used in testing for all kinds of automobile engine troubles



California's Pinon-Nut Industry

(Continued from page 7)

ing for piñon-nut dishes. The two staples go together

When the piñon cones or burrs begin to ripen and crack open, due to frost's effects, the nuts drop out like chestnuts. Then the Piutes spread their blankets under the trees and knock them off with clubs and poles. After this they are ingeniously cleaned by the squaws, who use fan-shaped willow baskets, tossing them in the wind until all the refuse is blown away The more adept its user the larger the basket. The older women are expert and handle a bushel a day each with ease. The cleaning is followed by the necessary process of roasting A pit is dug, a lot of rocks are heated, often by burning cones, thrown in, and the nuts spread over them and stirred until done Only an Indian can do this properly They dry out quickly after roasting and should be eaten within a few months. In the raw state they may be kept long in a dry, cool place Many are sold unroasted and the consumer is the loser thereby because the white man cannot bring out their best qualities in the finest oven yet designed

Each family or group of families caches its own supply, to be drawn as required, in cleverly-concealed places under rocks and leaves. Seldom do they steal from each other—never, before civilization was thrust upon them. Occasionally a white man stumbles upon a cache and helps himself In the earlier days a few palefaces lost their scalps through looting caches.

A few years ago it was an easy matter to exchange a sack of flour for a sack of nuts, while a few biscuits would buy a considerable quantity, but the red man has become sophisticated To offer him anything but real money is assurance that no nuts will be forthcoming. He understands monopoly like a war profiteer, he has learned all about the law of supply and demand.

The Indians grind the nuts into meal and make palatable bread and also a rich porridge They go to extremes in eating When they have to loosen their belts for comfort they give no thought to the days of possible emptiness ahead Sometimes a dusky glutton will overload his stomach with the nuts and seek relief from the consequent pain by external rubbing with liniment made of the same thing that caused it. The friction aids digestion and the liniment gets the credit. Nobody has thought of patenting this "heap medicine."

The piñon nut contains an astonishingly high percentage of fat—61.9, protein, 14 6, ash, 2.8, carbohydrates, 17.3, water, 3.4. It has the high fuel value of 3,364 per pound, and is credited with tonic properties beneficial to the entire human system. Fugitives and men lost in the lofty California mountain wonderland have sustained life on it alone for months and come out in good condition.

Bridging the Delaware at Philadelphia

(Continued from page 9)

beams and some bracing were designed for high strength alloy steel. A medium carbon steel was used for remaining steel construction except the cable and hangers of the suspension bridge design. For these high carbon steel wire possessing even greater strength than that used in the New York suspension bridges is available. In No. 6 size (.192 inch diameter) this wire has an ultimate strength of 215,000 pounds per square inch and an elastic limit of over 144,000 pounds per square inch

The report states that local conditions require that the cables be carried to an anchorage a considerable distance back of the towers and it is therefore economical to suspend the side spans from them. The cables and towers necessary for the main span sustain the fixed load of the side spans with but a very small increase in size and at little additional cost. It is desirable that the side spans be something less than half the main span in length

The dimension which has the most important effect on the economy of design of a suspension bridge is that of the sag, or versed sine, given the cables. This dimension is the vertical distance between the highest point of the cable curve at the towers and its lowest point at mid span On the choice of this depends the size of the cable, the height of the towers, the weight of the anchorage and the pressure on their foundations The stresses in the stiffening trusses are also in great measure influenced by it. For this design 200 feet was chosen as the versed sine best suited to the requirements of the bridge and its economy

By the simple expedient of placing the walkways on the upper lateral, bracing and grouping the vehicle and car road ways on the lower levels, the engineers considerably reduced the width of deck space The roadway is inside the carlines At first the engineers considered suspending the bridge from four main cables as in all the New York bridges But this would involve a width between outside tower legs of 118 feet and main pier caissons 170 feet long The two cable design adopted permits the two tower columns to be placed 89 feet apart and saves twenty five per cent in the cost of main piers alone It gives also a much more definite distribution of load to the cables

This choice required a notable increase in the size of cables. Those in the Brooklyn Bridge are fifteen and three-quarter inches in diameter The Williamsburg cables are eighteen and five-eighth inches, and the Manhattan twenty and a half inches On the Delaware Bridge the size determined on is thirty inches Despite the fifty per cent increase the manufacture and erection of the cables will involve no new or untried procedure, says the report. The wires will be laid in place individually and parallel to make up 61 strands, which will be subsequently bound together and wrapped with serving wire to make up the complete cable of 16,500 wires Every twenty and a half feet measured horizontally a circumferential cast steel saddle will be fastened to the cable, over which four galvanized wire ropes, two and five-eighth inches diameter each, will be hung to carry the suspended structure The cables rest on cast steel saddles on the towers and at the anchorages Back of the anchorage saddles they are fastened to anchor chains embedded in the mass of the anchorage masonry

The stiffening trusses were computed according to the Deflection Theory, first used on the Manhattan Bridge It is based on the behavior of the bridge as a composite structure and takes into account the part which the total weight of the structure plays in resisting the cable deformations. The stresses are computed for the specified moving load of 11,990 pounds per lineal foot, and a temperature range of 110 degrees, to cover all conditions of loading and temperature

The report states that in the early suspension bridges, with small spans and light loads, masonry towers were mostly used The Brooklyn Bridge, with its long span, has stone towers, but in all succeeding suspension bridges of that magnitude the towers have been built of steel. The reason for the departure from masonry is purely a matter of practical engineering. There is no doubt that well proportioned masonry towers produce a fine aesthetic effect, but structurally they cannot satisfy the engineering requirements of a large bridge.

Under various conditions of loading the resting points of the cables on the tops of the towers are subject to considerable horizontal displacements. Formerly, it was common practice to place the cable saddles on roller beds, which were relied upon to permit this motion. Experience on large bridges has shown that the

rollers and saddles do not move until frictional resistance of considerable magnitude has been overcome. This means that the towers must bend to permit this horizontal displacement. The large dimensions which masonry towers require to sustain the enormous reaction of a long span bridge makes them unfit for bending. The necessary lateral width causes difficulty in securing sufficient clearances at the point where the roadway passes through the tower. The cables will be rigidly attached to the tops of the steel towers, this with a view to avoiding the uncertainty of response of the rollers. Hence the steel towers are so designed that they can safely deflect in the plane of the cables as much as may be required to permit a balancing of the horizontal forces. The proper proportioning to bring this about, when the towers are fixed at their base results in slender and graceful lines. The strength to withstand the bending stresses in addition to the direct stresses is provided by the addition of the proper amount of material.

The towers are 12 feet wide at the top parallel to the cables, widening to 40 feet at the base. Transversely the width is seven feet. The anchorage masonry is designed as a monolith. Each will require 90,700 cubic yards of masonry, and will rest on gravel strata, and on inclined caissons extending down to rock or other satisfactory material. The horizontal pull of the cables combined with the weight of the anchorage produces a resultant inclined to the verticle about one foot in six feet. To avoid any possible doubt as to resistance to sliding of the anchorage it is intended to sink 20 small caissons to hard foundation with the same inclination as the resultant of the forces.

A program of widened streets to meet the requirements of the new bridge also has been suggested by the engineers, based on a comprehensive traffic survey. The board reports that the bridge can be built by July 4, 1926, the Sesquicentennial of the Declaration of Independence. Plans are now well along in Philadelphia for celebrating this with a world's fair.

Rock suitable for foundations was found at 86.7 feet on the Philadelphia side and 91.6 feet on the Camden side below mean high water at the site opposite Franklin Square, two blocks north of Market Street, Philadelphia, recommended by the engineers for the bridge. At other sites considered, the rock level was near the practicable limit of pneumatic foundation work, exceeding on one side of the river or the other 110 feet, below which depth the engineers find that men can work only in half-hour shifts.

The Condensing of Milk

(Continued from page 11)

is a sturdy six-cylinder affair that pumps the milk under a pressure of 3,500 pounds through a series of minute passageways, and this serves to atomise the globules of butter fat, *i.e.*, cream, so effectually that they do not again combine but remain evenly distributed throughout the fluid. Until this machine was developed it was found that in a can of evaporated milk the lighter solids would rise to the top while the heavier ones settled to the bottom, and the purchaser often mistook this condition as a sign that something was wrong.

The preserved milk we have been describing is that commonly known as evaporated milk, and is unsweetened. As it is expelled from the homogeniser it is forced first through the coils of a water cooler and then on through the pipes of a brine cooler where its temperature drops to 45 degrees Fahrenheit. Coming from the latter refrigerating equipment it pours into enamel-lined tanks whence it is fed to the filling machines that charge the cans familiar to all of us. The cans when filled and sealed are carried to the sterilizing room where they are exposed to the heat of live steam for from thirty minutes to an hour at a temperature ranging from 226 to 240 degrees Fahrenheit.

The sterilizer is, in effect, a boiler in which is mounted a revolving wheel-like structure capable of holding 6,720 cans at a time. When this framework is loaded, the big iron cylinder is sealed, hot water is admitted until the sterilizer is nearly filled, and then steam is applied to bring the temperature up and to maintain it there for the desired period. With hot water and steam used so widely in a factory of the sort in question, it is not surprising that an expenditure of three gallons is required for every pound of milk condensed. Therefore, the water supply must be abundant and of unquestionable purity. When the sterilised cans of evaporated milk have cooled, they are then ready to be labeled mechanically, packed in boxes, and loaded aboard cars for shipment. It is entirely practicable to receive the raw milk in the morning and to dispatch the finished condensed milk in the afternoon.

"Preserved milk," *i.e.*, sweetened condensed milk, is not run through the homogeniser nor is it sterilised after canning. About 16 pounds of sugar is added to every 100 pounds of raw milk while the latter is in the hot wells or after the bulk of a charge has been drawn into a vacuum pan. The sugar content plays the part of a preservative and thus obviates the need of the protective treatment of sterilising, and the sugar also prevents the separation in storage of the light and the heavy solids in the condensed commodity. But the use of sugar involves some very nice problems during the preparation of preserved milk, and the utmost care must be exercised to guard against "sandiness" due to the crystallization of some of the sugar. This grittiness does not really impair the product, but the public insists upon smoothness.

The avoidance of sandiness depends upon various things, *i.e.*, the manner in which the sugar is commingled with the "batch" of milk, the temperatures employed in the hot wells and the vacuum pans, and also the cooling processes relied upon in refrigerating the hot condensed milk when it is tapped from the vacuum pans. If the percentage of cane sugar fall below the requisite measure the result is a gelatinous milk or one that may spoil sooner or later, on the other hand, however, an excess of sugar, no matter how skilfully the condensing milk is handled, will, in all likelihood, induce sandiness. Needless to remark each manufacturer has his own ways of insuring a satisfactory outcome, and the raw milk obtained at the different seasons of the year imposes modifications in practice. One pound of the final product represents approximately two and a half pounds of fresh milk, and the water content averages about 30 per cent. Normally, milk has a water content of 87 per cent.

When the sweetened condensed milk has been run through the coolers, it is then led to glass-lined tanks from whence it is drawn off and supplied to the filling machines. The filling apparatus are designed so that their several cylinders will hold just enough milk to charge a corresponding number of cans, and in the course of a working day one of these machines will take care of 100,000 fifteen-ounce tins. Manifestly, in the preparation of both preserved and evaporated milk, the original bulk is reduced about one-half, and, similarly, the extraction of a large percentage of the water diminishes the weight greatly in proportion to the unit of remaining foodstuff. Therefore, results are realised that affect tremendously the space occupied and the weight to be dealt with during subsequent transportation and storage. In other words, when our condenseries turn out in a year a matter of substantially 2,061,000,000 pounds of concentrated milk—allowing for the sugar content in the sweetened class—the marketable commodity in the cans represents a saving in freight of quite 1,200,000 tons! At the same time they have conserved more than 4,504,000,000 pounds of an extremely perishable foodstuff and placed it within the reach of rich and poor everywhere.

Finally, it should be remarked that a steadily increasing percentage of the annual production of concentrated milk is what is known to the trade as "plain condensed milk," which is sold in bulk without being sterilised or preserved with sugar. Its keeping qualities, however, are greatly improved by the evaporation process to which it is subjected in the vacuum pans; and this milk, commonly shipped in 40-quart cans, is extensively used by confectioners and ice cream manufacturers. The condenseries, therefore, are contributing to the insistent and growing exactions of America's demand for sweets.

The Heavens for July, 1921

(Continued from page 12)

month, but is too near it to be seen. He passes through inferior conjunction on the 7th, and later comes into sight as a morning star, running out quickly to elongation on the 28th, when he rises at 3.30 A. M. He should be easy to see during the last week of the month.

Venus is a morning star, and reaches her greatest elongation on the 1st, 45° 44′ from the sun. She rises at 2 A. M., and is exceedingly conspicuous all this month.

Mars is just past conjunction with the sun, and, though theoretically a morning star, is practically invisible.

Jupiter and Saturn are both evening stars in Leo, only five degrees apart. On the 10th the former sets at 9 50 P M, and the latter at 10 10. Jupiter is moving eastward faster than Saturn, and steadily drawing nearer to him, but the conjunction of the two will not occur until they are lost in the sun's rays. We still see the dark side of Saturn's rings, but they are turned more and more nearly edgewise toward us, and after August 3rd the bright side will come into view once more.

Uranus is in Aquarius, and comes to the meridian about 3 A M in the middle of the month. Neptune is in Cancer, and unobservable, setting less than two hours after the sun.

The moon is new at 10 A M on the 5th, in her first quarter at 11 P M on the 11th, full at 7 P M on the 19th, and in her last quarter at 9 P M on the 27th. She is nearest the earth on the 6th and farthest away on the 21st. During the month she is in conjunction with Venus on the 1st, when an occultation is visible in Europe, with Mars and Mercury on the 5th, Neptune on the 7th, Jupiter and Saturn on the 9th, Uranus on the 23rd, and Venus again on the 31st.

Comets

Winnecke's comet, of which we spoke last month, passed perihelion on June 13th, and was nearest the earth on the preceding day at a distance of about 14 million miles. By July 1st it will be almost twenty million miles from us, and rapidly receding. According to an accurate ephemeris, computed at the University of California, its apparent position will be on July 1st 0h. 32 m R.A., Dec. 19° 55′ south, while on the 20th it will be in 1h. 21m and 34° 27′ south. Unless some exceptional brightening takes place, it will be invisible to the naked eye all through the apparition, and will be only of the ninth or tenth magnitude in July.

Reid's comet, discovered at the Cape in March, is now rapidly receding and growing very faint.

A comet was discovered by Dubrage, in Russia, on April 29th. According to elements computed at Petrograd, it passed perihelion on May 7th, at a distance of 107 million miles from the sun. It is moving in a direct orbit, with an inclination of 22°. A plot of the orbit indicates that it should remain visible in the evening sky for some months, receding from the earth and sun and growing fainter. No ephemeris for the present month is at hand.

Mt. Wilson Observatory, June 11, 1921.

IN THIS ISSUE:

SCIENCE COMING INTO ITS OWN
A GIANT JUNK YARD

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SPEEDING UP THE LAYING AND LIFTING OF RAILROAD RAILS —[See page 23]

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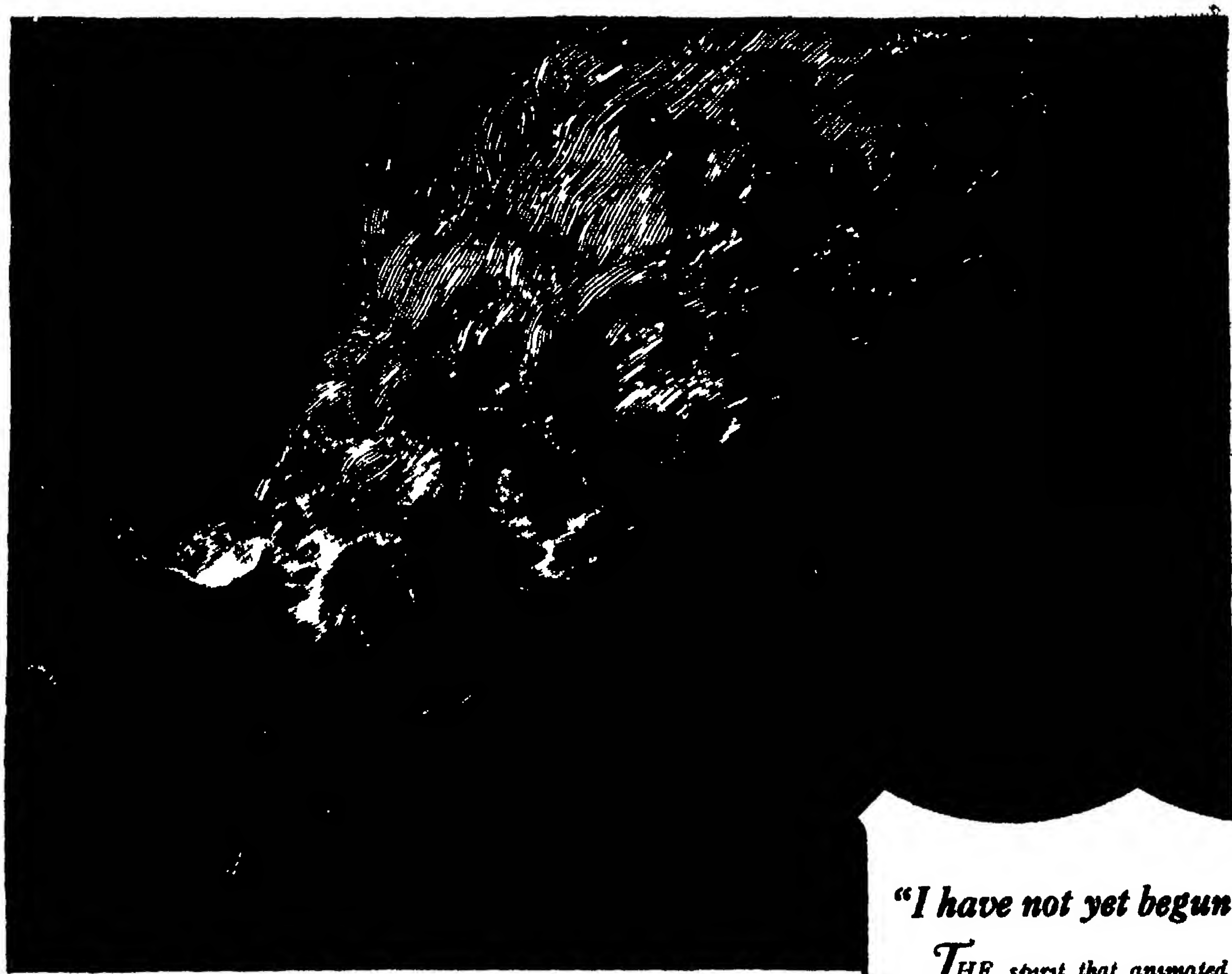

SEVENTY-SEVENTH YEAR

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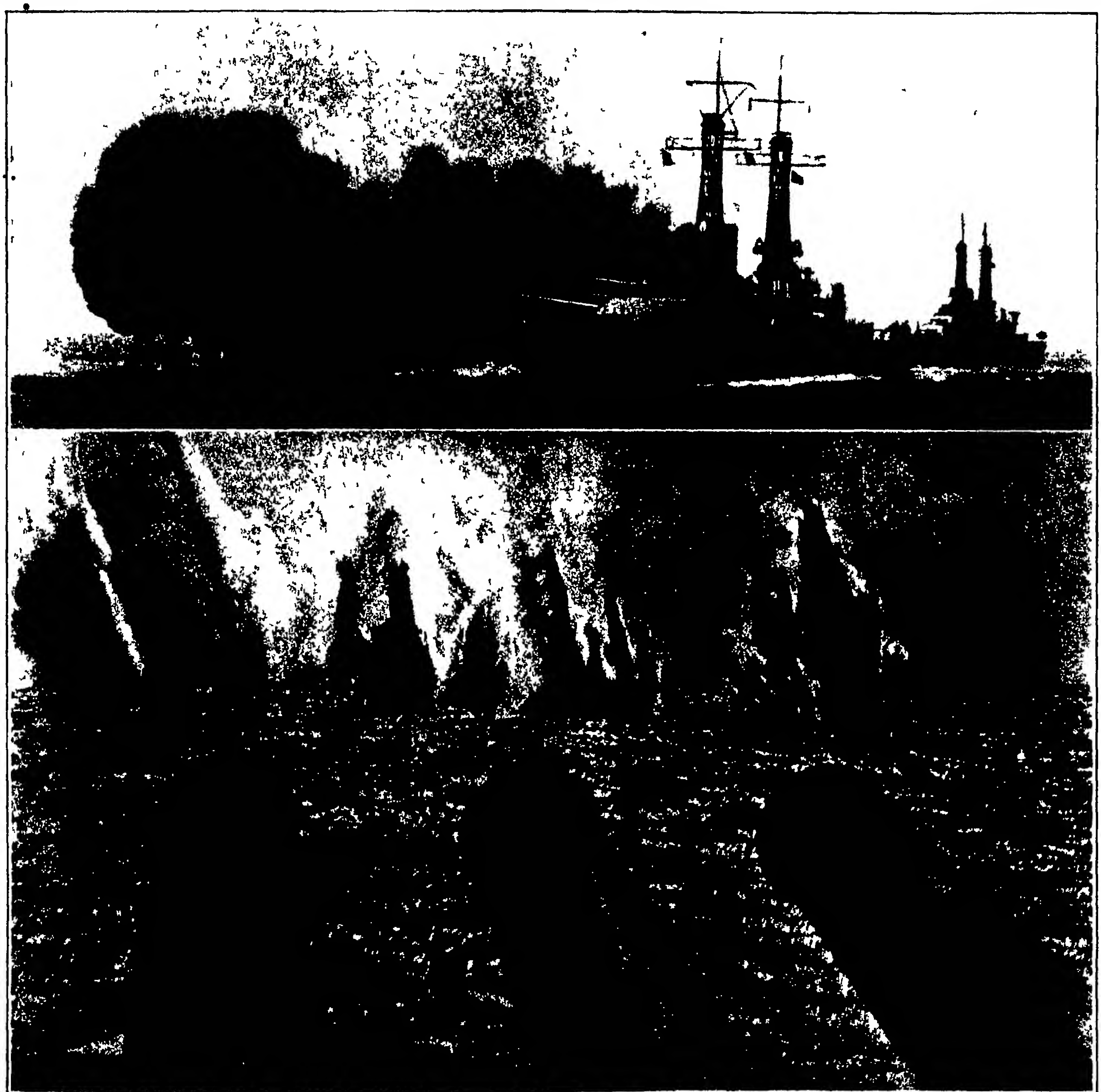

Photos, A. E. Wohl

Upper view: U S S. 'Oklahoma' firing a broadside off Guantanamo. *Lower view* The 'Oklahoma" salvo as seen from the towing ship Every one of these shells would have been a hit against a battleship. The target was entirely demolished and the salvo straddled in the most perfect manner from a gunner's standpoint.

Close-up view of recent Navy target practice—(See page 25)

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A Noble Presidential Precedent

FIVESCORE and seven years ago, the Secretary of State of our young republic penned a notable letter to the American Minister in London So filled was this letter with noble purpose, so rich with statesmanlike vision that we should like to see it cast in bronze or graven in stone and set up as a permanent memorial in the legislative halls of Congress The letter written by Monroe in the year 1814 1815, was as follows

"The information you give of orders having been issued by the British Government to increase its naval force on the lakes is confirmed by intelligence from that quarter of measures having been actually adopted for the purpose It is evident, if each party augments its force there with a view to obtaining the ascendency over the other that vast expense will be incurred, and the danger of collision augmented in like degree The President is sincerely desirous to prevent an evil which it is presumed is equally to be deprecated by both Governments He therefore authorizes you to propose to the British Government such an arrangement respecting the naval force to be kept on the lakes by both Governments as will demonstrate their pacific policy and secure their peace He is willing to confine it on each side to a certain moderate number of armed vessels and the smaller the number the more agreeable to him or to abstain altogether from an armed force beyond that used for the revenue You will bring this subject under the consideration of the British Government immediately after the receipt of this letter"

The letter was duly received and considered, and out of it arose that too-little-known but momentous treaty called the Rush Bagot Agreement, according to which both the United States and the British Governments agreed to limit their naval armaments on the Great Lakes On Lake Ontario each Government was to maintain one vessel not exceeding 100 tons burden, equipped with one 18-pound cannon on the upper lakes each was to maintain two vessels of the same burden and armament, and one on Lake Champlain All other armed vessels on the lakes were to be dismantled, and no other vessels of war were to be thereafter built or armed

You may search all the records of diplomacy as far back as diplomacy has existed and find no single act that displays broader wisdom or greater moral courage, or that has been more prolific of beneficial results. Judged as an act of statesmanship it has been pronounced the highest achievement of the English-speaking races. That this pacific move, made by the President of the United States immediately at the close of a bitterly-contested war, has been fruitful in the way that he suggested it would be, is proved by the fact that the two greatest powers of the world, the United States and the British Empire have lived in peace for over 100 years although their adjacent territories, for a sheer stretch of 4000 miles, have not a fort or a cannon or a soldier to guard their frontier on either side

Today, at the close of another great war, in which the two nations have fought, not against each other, but as staunch allies against a common foe, a similar overture has been made, this time by the Government to which Secretary Monroe addressed his letter of 1814. The overture has come, it is true, not in the form of a diplomatic letter but rather as an open declaration of attitude or policy made in Parliament by the British Premier Speaking of the desire of Great Britain to cooperate with the United States in its world policies, particularly in the matter of armaments, he declares

"We look confidently to the Government and people of the United States for their sympathy and understanding in this respect. Friendly cooperation with the United States is for us a cardinal principle, dictated by what seems to us the proper nature of things, dictated by reason quite as much as by instinct and common sense We desire to work with the great republic in all parts of the world We desire to avoid the growth of armament, whether in the Pacific or elsewhere We are ready to discuss with American statesmen any proposal for limitation of armaments which they may wish to set out."

Different from Monroe's letter of 1815 in its wording, but identical in its spirit and purpose is this pronouncement by Great Britain upon the question of world policies and armaments. But, the people of the United States are thoroughly in favor of limitation of armaments, and their representatives in Congress have notified President Harding, or shortly will do so, that this is the expressed sentiment of the people Our President therefore is in a position to produce on a world wide scale those same beneficent results which sprung from that letter of one of his predecessors written fivescore and seven years ago. The President, however, for certain reasons which he does not disclose, seems to hesitate in making any definite move toward calling a council for the adjustment of this stupendous question Meanwhile, naval construction is going full blast in the navy yards of the world and it would seem to many probably to most of the American people, that this delay for whatever cause it may be, is endangering a great cause The two other leading naval powers have expressed themselves through their most prominent statesmen—for Japan has made announcements equally authoritative with that of Lloyd George—as being heartily desirous of meeting the United States for a discussion of the question of armaments

The delay in this vital world matter is to be laid at our own door Why do we hesitate? It cannot be that the President is awaiting a mandate from the country—its voice in favor of conciliation around the green table is unanimous and unmistakable It has been suggested that the Government knows of certain disturbing facts in the International situation of which the public knows nothing. Well, if so, is it not better to settle such matters now, over the table, than later in a bloody war?

How Fast Do Birds Fly?

EVERYONE surely who has watched the flight of the swifter birds has, now and again, made his own estimate as to the speed at which they sweep by The speeds attained by the carrier pigeon, the duck and the faster of the sea birds have formed the subject of endless guesswork and inevitable exaggeration Birds which are incapable, even when at full stretch, of doing more than 40 to 50 miles an hour, have been credited with 100 and over, and we remember reading somewhere the serious statement by a man who was both naturalist and huntsman, that when he was lying in wait for ducks he had more than once seen a flock of geese pass overhead across a certain measured stretch of landscape, that must have been going at least 120 miles an hour—and this in still air

Now the fact of the matter is that nothing is more difficult than to judge of the speed of any object through the air by mere human observation Foreshortening due to perspective alone renders it impossible to tell just when a moving object passes above some fixed point on the ground, and almost invariably the estimated speed is far beyond the actual. At the present time the highest well-authenticated speed is that of homing pigeons, some of which have reached a speed of 60 miles an hour over comparatively short distances.

But now comes Colonel R Meinertzhagen, a noted ornithologist in Great Britain, who has recently published some data on this subject in the *Ibis*, which is the leading English journal devoted to bird life The colonel states that during his anti aircraft duties in the course of the war, he trained his men in instrumental work by making them take observations of the flight of birds These he collected and then confirmed their results by instrumental work himself. He tells us that the speed of birds, as thus accurately ascertained, is far below what it is popularly believed to be, varying from 20 to 40 miles for the smaller passeres to from 40 to 50 miles an hour in the case of waders. Those speeds represent steady flight, but when a bird is frightened by an enemy, or when it is pouncing upon its prey, it can accelerate greatly for a limited time. He estimates that for a short distance the swift can reach a speed of 100 miles an hour.

The airplane, therefore, has greatly surpassed the swiftness of the birds both in its power of sustained speed and in its maximum speed. From 100 to 120 miles an hour can be maintained by many of the standard machines, and we know that last year the racing speed was carried up to from 180 to 190 miles per hour

Where the birds still greatly surpass the human flying machines is in the matter of taking off and alighting. The seabirds, and all birds in fact, by changing the angle of incidence of their wings, are able to reduce their landing speed at a rate which the airplane and the seaplane cannot at present approach.

Important Patent Legislation

IT is probably not known to many inventors that the laws of many foreign countries require a patent obtained in those countries to be worked there within a certain time limit which is determined by the statute It is considered by many that this requirement works a hardship to American inventors, in that the inventor is supposed to establish an industry covering his invention in that foreign country, whereas, as is well known, no working time is set for anybody obtaining a patent in the United States.

Senator Stanley has introduced in the United States Senate a bill designed to remedy this discrimination It provides that patents issued to persons not citizens of the United States shall contain a proviso to the effect that if such patent is not worked or put in operation so as to result in actual production of the article in reasonable quantities in the continental limits of the United States within the period of two years from the date of issue, the United States reserves the right to license any person, or persons, for purposes of manufacture, use and sale in the United States, and it fixes the royalties, the manner of payment and the penalty for failure to pay

It should be borne in mind that when foreign patents are granted certain taxes have to be paid by the American inventor annually, and that the patent is forfeited in case these taxes are not paid, and furthermore, in certain countries, as stated above, in case the patent has not been "worked" in that country Germany in particular has been very exacting in regard to the working of the patent within the limits of the Empire It has now been found that the Krupps, of Essen, Germany, have recently filed a very large number of applications in this country, some 228 in all, and it is with a view of compelling the foreign inventor to establish an industry in this country that the legislation in question has been proposed.

It has been the policy of the United States to keep aloof from any such legislation as that proposed, or the paying of annual taxes. Of course there is a great deal to be said on both sides of the question, and it is hardly likely that the bill would have been introduced into the Senate were it not for the great number of applications which have been introduced by the Krupps. Furthermore, it is a grave question whether the proposed bill will accomplish the result for which it is designed. In the year 1909 a treaty was entered into between the German and the United States Governments in which it did not become necessary for an American applicant to work his invention in Germany Of course, all the treaty obligations were laid aside by the war, but when peace is once declared it is highly probable that all the former treaties will be reenacted or, at least, will come again into operation. If a law should then be passed under which burdens were imposed upon the German subject here which an American citizen is not compelled to meet in Germany, it is only fair to assume that a retaliatory legislation would be resorted to by Germany which would do away with any advantage that might be gained under the proposed law This proposed change in our patent law would affect most severely Great Britain, France and other countries with which we were allied during the war, so that it is a grave problem whether the advantage sought after would be reached by passing the suggested legislation.

Electricity

A Canopy Switch.—Packing a real snap switch mechanism into the confines of a small structure is a feat that has been successfully accomplished by a company manufacturing switching devices. The tiny switch is intended to fit into fixture canopies and plates, as well as the bases of portable lamps the dimensions of which must be kept small.

Oil Conservators for Power Transformers.—A leading electric company has developed an oil conservator which eliminates sludging as a result of exposure of hot oil to oxygen. Only in rare instances, so it is claimed by the manufacturing company, can any moisture condensation take place, and then it is absolutely confined to the conservator where it is trapped and may be drawn off without its coming in contact with the main body of the insulating oil, thereby greatly reducing the work of keeping the oil up to proper dielectric values.

Precision Form of Kelvin Electrostatic Voltmeter.—A paper read before the Institution of Electrical Engineers describes a form of electrostatic voltmeter for precision measurement. The instrument follows the general arrangement of the Kelvin type. The chief modifications are (1) Very considerable reduction in weight, permitting (2) the use of a bifilar suspension to overcome the effect of elastic fatigue; (3) a modification of the shape of the needle to produce a more satisfactory "scale law" for both small and large deflections, and (4) the provision of various mechanical details to facilitate construction and adjustment.

Electric Fans for Limousines.—A manufacturer of small motors and fans has recently developed a special electric fan intended for use in the usual closed car and in ambulances. The main features of the fan are given as follows. The battery wires are 6 inches long, the bracket has a double joint with rigid set pins and several points of adjustment for tilting the fan to any angle; the fan is easily fastened to the ceiling or any other part of the tonneau, with a few feet of connecting cord and a control switch placed at a convenient point in the line it is easily attached to the storage battery of the car, the current consumption while running is 1.5 amperes.

Power Transmission at 220,000 Volts is scheduled to become an accomplished fact in the near future, according to *General Electric Review*. Confidence in the attainment of this transmission voltage has long been inspired by the successful operation of 150,000-volt lines, but the actual construction of such an installation has been delayed by the diverting activities of war. Under such a degree of pressure the concentration of energy is so great that 100 horsepower could be transmitted by the filament in an ordinary 40-watt incandescent lamp without heating this minute conductor above its normal operating temperature or shortening its rated life.

Electrification of Sweden's Railways.—The Riksgransen Railway lies wholly within the Polar Circle, thus necessitating special appliances to contend with the snow. Except for the stations, the railway is single-line throughout, of standard gage, with a maximum grade of 1/100, and sharpest curve of 500 meters radius. The whole line is being electrified, according to *The Technical Review*, the power being supplied by water. On the electrified line trains of 40 mineral-carrying cars and brake van are hauled by two locomotives, which is an increase of 40 per cent, with a speed increase of 50 per cent over the original steam traction. Power is generated as single phase current at 80,000 volts, and stepped down in four substations to 16,000 volts on the overhead conductors.

Atmospheric Electricity for Power.—Mr. Hermann Plauson, on the basis of recently conducted experiments which were described in the SCIENTIFIC AMERICAN MONTHLY some months ago, is of the opinion that an inexpensive and unlimited supply of electrical energy may be obtained from the atmosphere. He has even published a book on the subject. As antenna he uses a captive balloon having a metallic cover provided with a large number of pointed projections or spikes, and allows it to ascend to a height of 1,000 or 1,600 feet above ground. Positive electricity is then collected from the air and transmitted to the ground through a wire rope fitted with sparking gap, which in turn produces an electric vibration in a circuit. M. Plauson obtained with one balloon at a height of 1,000 feet a supply of 17.28 kilowatt hours per diem, and with two balloons 91.6 kilowatt hours. He calculates that a battery of 10 balloons should give an annual supply of 210,000 kilowatt hours. The idea of extracting electricity from the air is not a new one, although nothing of a practical nature has been realised to date. However, it seems to be among the future possibilities.

Science

Esperanto in Italy.—Esperanto has now been recognized by Italy as a "clear" language for telegraphic purposes, and is no longer considered as a cipher or "conventional" language.

Again the Paris Platinum Thief.—Platinum vessels used for chemical analysis and other apparatus, worth altogether $14,000, were stolen from the laboratory of the Prefecture of Police in Paris recently.

Smokeless London.—For once London is "spotless town" for now for the first time in centuries London can breathe and smell fresh air for the curse of soft coal is removed by the coal strike.

Flies in New York.—Owing to the fact that refuse must now be covered and that few other places are left to breed, the common housefly is becoming rather infrequent in the more settled part of New York but not in the outskirts. Many of the high class apartments no longer provide fly screens. Asphalt, concrete, and the covered garbage pail have done wonders in mitigating the evils of this pest.

Ice in the Fairways of Commerce.—Ever since the loss of the "Titanic" the U. S. has worked steadily to eliminate one of the twin highwaymen of the sea—ice. Old shipmasters say icebergs 'carry no side lights,' but with the aid of the wireless two of our cutters with headquarters at Halifax patrol the lanes and keep a close watch for the cold and beautiful bergs which have been found sixty miles below the usual zone of travel. The other twin—fog—cannot be watched and warded against.

Annual Tables of Constants and Numerical Data.—The publication of the Annual Tables of Constants and Numerical Data, Chemical, Physical and Technological, which was interrupted during the war, has now been resumed by an international commission acting under the authority of the International Union of Pure and Applied Chemistry. The volumes are quite expensive, and those interested should address the American Commissioner, Prof. E. W. Washburn, University of Illinois, Urbana, Ill.

Appreciation by Mme. Curie.—"I feel that I have three countries—the land of my birth, the land of my adoption, and the land of my new friends," Mme. Curie, co-discoverer of radium, said on sailing in expressing her appreciation of American hospitality during her seven weeks' visit here. "It is with much regret that I come to the last day of my visit in America," Mme. Curie said. "There has been only one disappointment, that has been my physical inability to do all the things I would wish to do and to meet all of the American people I much desire to meet. My work with radium, and especially during the war, has so damaged my health as to make it impossible for me to see many of the laboratories and colleges in which I have a genuine interest."

A Classic Hoaxer Passes Away.—Louis de Rougemont certainly gave Ananias, Munchausen, Dr. Swift and Sindbad the sailor an awful run. He has just died in a London pauper infirmary. It is extraordinary that a man of such wonderful imagination should have died in poverty. Even his real name was appropriate for his wholly untruthful career for it was Henry Louis Grin. Twenty-five or thirty years ago de Rougemont astonished the world by a series of yarns about savages and cannibals which made Defoe's masterpiece look tame. He claimed to have married a cannibal wife. His writings were accepted for a time and he even addressed the British Association on the habits of the Australian aborigines, but at last he was unmasked by an English newspaper and it was proved that he was working for a Swiss banker while he was astonishing the natives as a cannibal king.

Fulton's Panorama Passes Away.—A last memory of Robert Fulton passes from Paris with the destruction of the Café Vernon. There was still above the door, in the large bronze letters of another age, "Café des Panoramas," and the panoramas were built in 1799 by Robert Fulton. Says Stoddard Dewey in *The Evening Post*: "He had a patent for them, covering the improvement which he had made in the original invention. This he had purchased from Robert Barker of Edinburgh, who had the idea and realized it roughly twelve years before. It was a triumph of Yankee ingenuity and it pleased Napoleon, whom it helped in politics. Fulton had to go back to America after seven years of Paris to get his steamboat running, but his panoramas remained on the Paris boulevards until 1831 and the café for their patrons until now. There were two panoramas, one showing a view of Paris from the roof of the Tuileries and the other represented the Evacuation of Toulon by the French in 1793. Robert Fulton came to Paris to study art."

Aeronautics

Aviation School for Bolivia.—There is a project on foot which has the approval of the Bolivian Government for the foundation in that country of an aviation school for the purpose of developing commercial flying and improving communication with adjoining countries. Included in the equipment of the proposed school will be hangars, mechanics' shops, photographic workshops, and other supplies.

Paris to Warsaw.—Beginning April 2nd an aerial post was put into operation between Paris and Warsaw. The airplanes start every Tuesday and Saturday at 8 A. M. Letters, post cards, periodicals, newspapers, commercial papers, samples of goods, ordinary and registered, may be sent by this post. The charge for letters from Warsaw is 30 marks to Prague, 60 marks to Strasburg, and 105 marks to Paris for the first 20 grams. These letters or parcels are received at the main post office from 8 A. M. to 8 P. M. and on the day of departure at 6 A. M.

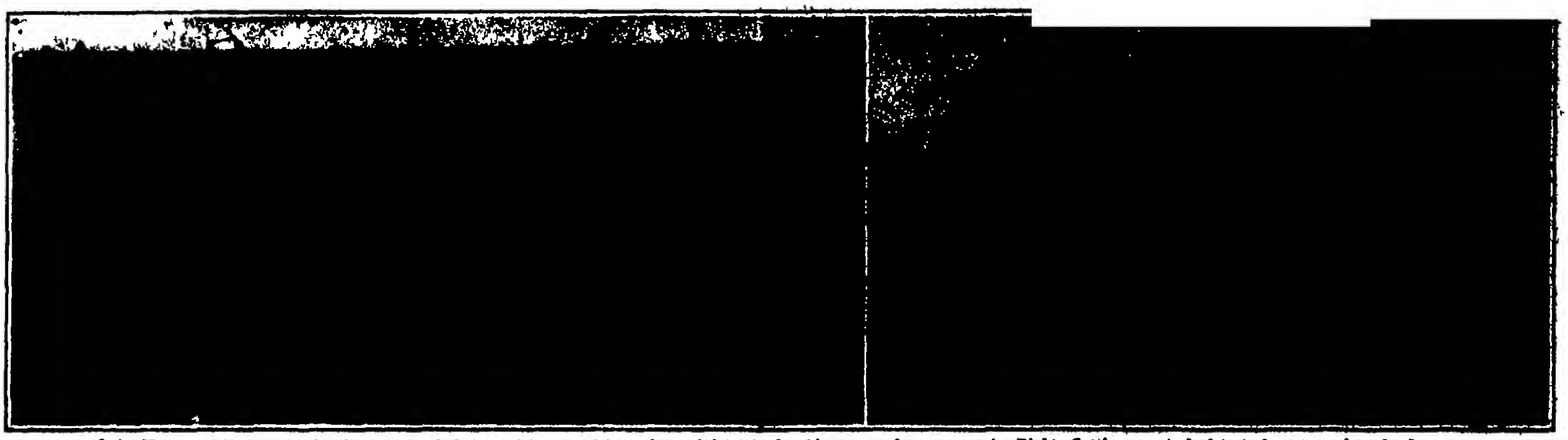
Dirigible Frame Metal.—It is stated that scientists in a Pittsburgh steel mill have discovered a formula, long sought by British and American naval authorities, which the Germans used in the construction of frameworks of Zeppelin dirigibles. Hitherto nothing has been known of the composition of the aluminum alloy used in the framework of Zeppelins save that it was lighter than steel and of great tensile strength. It was determined that the strength of the metal lay in its treatment by heat, and scores of attempts were made to determine the proper temperature. The scientists, however, have discovered something else essentially American, which will go into the new alloy.

Kongo Airplane Service.—It is reported that the directors of the Forminiere Diamond Mines Company have suggested the inauguration of an air service by seaplane, which would operate between the mines at Djoko Punda, on the Kasai (a tributary of the Kongo) and Kinchassa on the Kongo—from which latter point the railroad runs to Matadinoki, a steamer port on the lower Kongo. The directors offer to defray the greater part of the initial cost of the scheme. In the meantime a survey of the route is being undertaken. The distance from Kinchassa to the mines is approximately 500 miles which could be covered in two days, as contrasted with over a month by the existing river transport.

The New Morane-Saulnier Monoplane.—We learn from *Flight* that M. Saulnier, the well-known French designer, has just completed the designs for a large cantilever monoplane which is to have seating accommodation for 16 passengers, and will be driven by three Lorraine-Dietrich engines, of which two will be placed in the leading edge of the wings, after the fashion of certain German planes, and the third in the nose of the fuselage. The monoplane wing will have a span of 88 feet 6 inches, and the wing area will be 1,250 square feet. The weight empty has been estimated at 9,450 pounds and the weight 'all on' at 15,400 pounds. It is estimated that the machine will take off with two engines, and fly at 1,500 feet on one engine.

Laying Mines by Means of Aircraft.—A new method of planting mine fields, involving the use of aircraft and a special type mine equipped with a parachute, has been the subject of recent experiments conducted by the Navy in Chesapeake Bay, according to reports. The mine used is the invention of Charles Lee, a mechanical engineer of Portsmouth, Va. The mechanism, according to *Aerial Age Weekly*, consists of the mine, anchor, cable and silk parachute. Large numbers of airplanes, each carrying a supply of mines, can be sent over the area to be mined, and the devices dropped at regular intervals. The parachute eases the descent to the exact spot selected, and the instant the mine hits the water the parachute is detached and floats away to sink later.

Altitude Cockpits.—When considering altitude flights for commercial purposes, writers often lay considerable stress on the difficulties to be met in designing passenger cabins. Oxygen tanks, air-tight walls and temperature and pressure regulators are stipulated among others, states *Aviation and Aircraft Journal*, and great difficulties are foreseen in developing this equipment. Vane-driven air compressors, continues this authority, would probably obviate the use of oxygen tanks and a simple system of intake, exhaust and relief valves might take care of ventilation in the passenger cabin, which would have to be constructed with perhaps greater care to details than is usual. Exhaust gas heating, or electrical heating, comparatively easy to construct, would maintain a comfortable temperature in the cabin. Taken altogether, we are told, the difficulties to be met in providing for altitude flying appear to have been somewhat exaggerated.



Left: Heavy machine parts that have outlived their usefulness and have descended to the humble estate of scrap metal. *Right:* Cutting up steel plate to be returned to the furnace

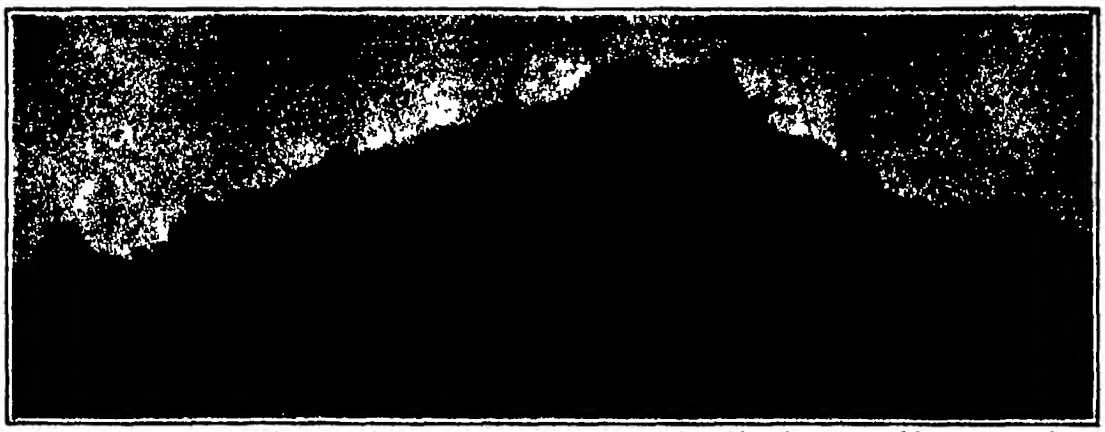
Some of the more bulky properties of the junk man

A Giant Junk Yard

A Plant that Handles Anything from Discarded Battleships and Abandoned Railroads to Old Tin Cans

By William A. McGarry

IN these days of tremendously expanding industry the world's greatest engineers and scientists are engaged in a constant search for new sources of raw material, while thousands of experts devote all their time to the development of economics. Looking ahead ten, twenty, fifty or a hundred years, chemists and geologists and the big men in a dozen other lines toil to produce substitutes for everything from fuel to paper. Already the world is nearing the end of existing supplies of many raw materials, but somehow even the more far-sighted men of science and industry have expressed no fear of a metal shortage.



Hundreds of miles of barbed wire that never saw France. It may be sold to farmers, and it may go to the Orient for the manufacture of ornaments

On the surface this may appear to be a blunder. Man's uses for all the metals increase every day in number and extent. It is probable that the great bulk of all new patents call for the use of iron, copper, brass, tin or some other metal. In steel alone the production is so huge and the growth of the industry has been so tremendous that even in the face of deposits that seem inexhaustible one would expect the question, "What shall we do when the supply of raw material is gone?"

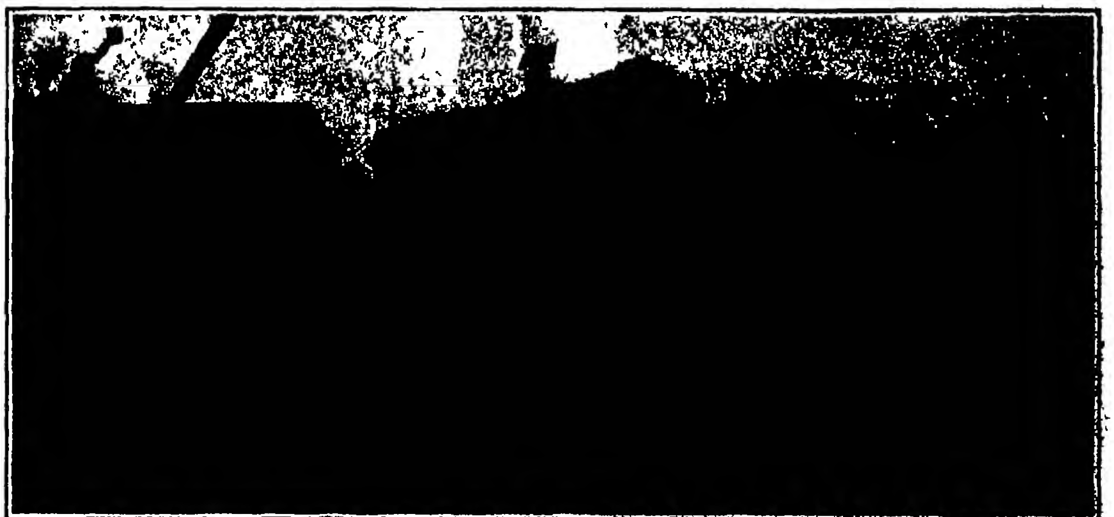
The answer is to be found in any metal-junk yard. It throws a new light on the value to civilization and progress of these products of the earth. For metal alone of all the raw materials wrested by man from the earth for use in building his cities, transporting his commerce and furnishing his pleasure and entertainment, never really wears out. Machines break down or are superseded by better ones, bridges collapse, ships become too old for service and boilers burst or become unsafe. But modern metallurgists — and countless thousands of workers steeped in the ancient lore and tradition of the iron worker but absolutely devoid of any scientific knowledge—can take the rusted, battered remains and turn out new lathes and locomotives new rip-saws and razor blades, that will give first class service and "last a lifetime."

In a way the romance of metal is perhaps the nearest approach man achieves to the efficiency of nature on a large scale. The earth produces food and then utilizes the waste to enrich the soil for further food production. It is a chemist that never sleeps. Man imitates this cycle in salvaging textiles, paper and other materials for reuse in some other form, but nowhere is his percentage of success as great as in metal.

No one who has not inspected a great metal-salvaging plant can realize the extent of his success, or grasp its future possibilities. Officials of the Philadelphia company whose forty acre riverside plant is said to be the largest in this country, admit that the business is really in its infancy. With a half century of experience in handling everything from scrap from tin-can factories to worn-out battleships, this firm is still developing new means of utilizing metal scrap that in former years went on the dump heap as valueless.

The plant is located on the banks of the Delaware River and is the largest of a half dozen yards maintained by this company. Half of its acreage is covered with every conceivable kind of metal junk, and several hundred thousand tons more are tied up to the piers in the shape of monitors, torpedo boats, worn-out ocean liners and other discarded vessels. Just inside the main entrance gate is a small mountain of shiny, curled scrap which offers one of the best object lessons of progress in the field of salvage.

This stuff comes from the can factories and other tin plants. It represents waste in the manufacture of everything from the lightest kitchen ware to the heaviest galvanized utensils. For years tons of it were thrown away. Because of its extreme light weight the scrap curls in all directions, with the result that it takes up a great deal of space. It was so bulky and so difficult to handle that it was not worth while for industry to attempt to save it. Even when the demand for finished products ran far ahead of the supply of raw material from the original sources — the mines — manufacturers could not find a method of utilizing this scrap. Its bulk may be indicated by the fact that ten tons will fill an ordinary coal car.



Steel "skulls" from the rolling mill furnaces awaiting treatment at the junk yard

A few years ago this junk concern made inquiries and learned that there were many tin plants which would be glad to use this material if it could be reduced in bulk. The firm promptly installed a hydraulic press. Its chamber is twenty inches wide, four feet deep and six feet long. It is not

(Continued on page [illegible])

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By [illegible]

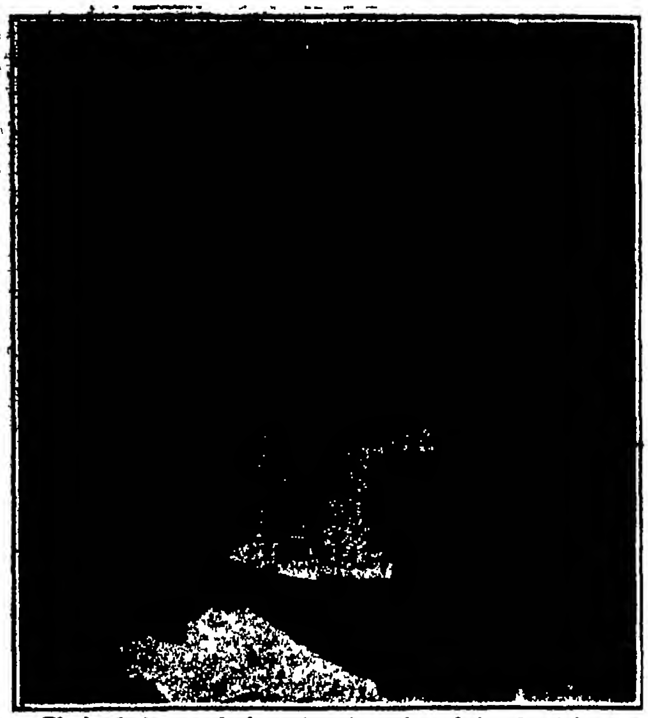
A SURVEY of investigations, embracing a three-year period, as conducted by the Clay Products Section of the National Bureau of Standards, has established the merits of domestic clays for the manufacture of glass. Hitherto America has relied upon Grossalmerode, Germany, as an exclusive source for glass refractories, little knowing that portions of Tennessee, Kentucky, Arkansas, Ohio, and Illinois, are veritable mines of clay products.

Plasticity, bonding power, and strength are the desired properties figuring in the selection of clays for the glass industry. The fire shrinkage of the American bond clays as contrasted with the imported product is a disparagement in favor of the latter. The extreme furnace shrinkage, however, according to Government scientists, can be overcome by the incorporation of a sprinkling of siliceous clay or sand, by increasing the content of grog or by sizing, and by the use of higher pot-arch furnaces. Siliceous clays, perhaps the most feasible remedy, are plentiful in New Jersey, and sandwiched among the fire-clay deposits of Missouri, Kentucky, Tennessee, Ohio, and Pennsylvania.

That the porosity of the pot body be as low as possible when the glass charge is introduced, is a prerequisite in glass making. Seemingly, this is contradictory to the requirement that the fire shrinkage be low, whereupon, the Bureau of Standards suggests a compromise by using with the siliceous clay a material burning dense at the furnace temperature. German clay has a porosity of 16.9 per cent at 1,290 degrees Centigrade whereas a Missouri product shows only 8.96 per cent. A happy medium is possible. The Arkansas clay, having a porosity of 25.6 per cent at the above-mentioned temperature, requires a larger volume of dense-burning clay to attain the prescribed degree of compactness. Extreme caution in drying glass pots and tank blocks is essential; otherwise irregularities will be evident when the pot has been placed in the melting furnace.

American clays resist the corrosion of glass more satisfactorily than the imported product. By way of disparagement, while the German clay is resistant to corrosion sufficiently to meet the requirements for glasses of the soda-lime type, it does not compare favorably in contact with flint glass. The rigidity of siliceous clay at furnace temperatures—its capacity for resisting pressure without deformation—is another feather in its cap. On the other hand, it has a tendency of being fragile when being manipulated in the furnace, a weakness which expresses itself by an inclination to spall under sudden temperature changes.

Looking to the development of American bond clays, a ceramic chemist of the Bureau of Standards recommends the abandonment of the pot arch construction in vogue and substituting therefor either the down-draft or the up-draft firing common to clay industries. Preferably, the firing should be done from two sides, over bag walls, copying the arrangement of the rectangular down-draft kiln employed in brick burning. A perforated kiln bottom permits the guidance of heat and flames at will, a condition insuring the burning of the bottom of the pots which are placed on blocks. Either the down-draft or up-draft firing, provided ample space is available, renders it feasible to preheat the pots to a higher temperature, possibly, 1,200 to 1,300 degrees Centigrade. Thereby, a maximum degree of fire shrinkage will be accomplished here instead of deferring the process until the material reaches the melting furnace. Such an attainment is desirable.



Block of glass made from American clays, being freed from its coat of slag

Special type of mold for the casting of glass pots

A Radio Link in Our Telephone System

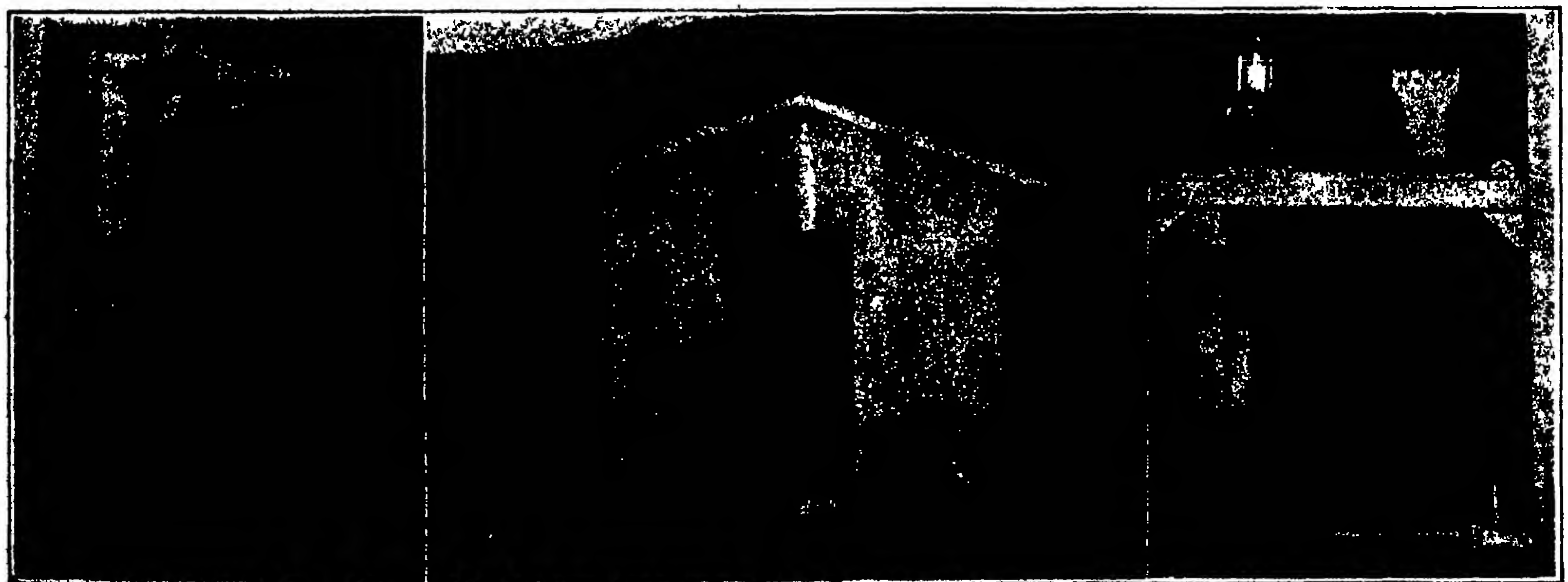
By Frank B. Howe

COMPLETING the latest link in the chain of devices for commercial communication, the first radio telephone to be opened to the public has been established between Catalina Island, California, and the mainland by the Pacific Telephone and Telegraph Company. The system not only establishes telephonic communication between the island and mainland but it can be plugged into the regular telephone service and connected to any subscriber's phone without additions or changes in the regular house instrument. In fact, since the establishment of the service, a heavy concessionaire on the island, William Wrigley, Jr., has been holding daily conversations from his residence in Chicago with his managers on Catalina Island.

The mechanism of the commercial radio telephone is anything but bulky. Walking around the island from the little town of Avalon, one comes eventually into a little cove, free from everything in the way of civilization that would tend to interrupt the waves of the wireless. There are two little white houses, about ten feet square, and two high aerials. That is all. In one of the little sheds is the mechanism for sending messages, or transmitter. In the other is the receiving instrument, which looks much like an ordinary telephone exchange desk. A generator for charging the storage batteries used in the system, completes the list of instruments.

The land end of the system is located at Long Beach, a small city on the southern California coast. Here the connections are made with the regular service, over wires. The charge for a wireless message is no greater than for an ordinary long-distance call—40 cents for three minutes. The distance from Catalina to the mainland is 26 miles.

That the system is successful there is not the slightest doubt. One can hear as clearly as over the common type of phone and calls are made with equal promptness. One man constitutes the entire working force of the island station. When the writer called the one-man force was out swimming—calls were being made every few minutes but the mechanism was taking complete care of them all by itself and there was nothing for the crew to do.

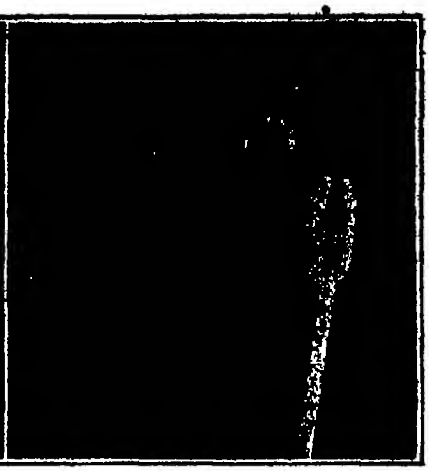


Left: General view of the [illegible] showing its simplicity. Center: Small building containing the transmitter for sending out the radio telephone waves to the mainland. Right: Close-up view of some of the [illegible] apparatus. Note the oscillation and modulation vacuum tubes in upper left-hand corner, the variometer tuner in the center, and the variable [illegible]. All the components of the transmitter, excepting such accessories as the motor-generator set, are mounted in the angle-iron frame

Radio telephone station on Catalina Island, which maintains communication with the California mainland and thence through the usual telephone system

One of the 12-foot Pelton wheels

Power station, showing the four units each of 3000 horsepower capacity



Method of keying the buckets to the wheel

Hydraulic Power Under a Mile-High Head

Some Interesting Details of a Remarkable Pelton-Wheel Installation in Switzerland

AT a distance of a few kilometers from Martigny, in the Rhone Valley, at Fully, Switzerland, will be found a hydroelectric installation which has its own claims to distinction. A power house nestles among the trees of the valley, and above it, 7,000 feet above sea level and between 5,000 and 6,000 feet above the power house, is an Alpine lake, the waters of which, coupled with the difference of over one mile in elevation, *furnish the source of power for the generating* station. The water is piped from the lake to the power house in a line whose location is indicated by the dotted line in one of our illustrations. The pipeline is 2.85 miles in length and is connected with a tunnel 1,650 yards in length, which is partly under pressure. The net working head is 5,412 feet, which, so far as we know, entitles *the Fully plant to first place in* respect to operating head among the power plants of the world.

At the generating station, the water is led to four large Pelton wheels 12 feet in diameter, built of forged steel, each of which carries 54 buckets on its periphery. The method of fixing the buckets is that of Messrs. Pickard Pictet, *of Geneva*, who built the wheels and who are responsible for the hydraulic part of the plant. It will be noticed from one of our illustrations that the buckets, A, are mounted in a mortised groove, B in the periphery, D, and that they are held by keys, C, which are driven between them. Each of these wheels develops 3,000 horsepower when running at 500 revolutions per minute, and each has a single jet, which strikes the wheel horizontally at its lowest point.

The wheel is fixed on the turbine shaft by means of a cone keyed to the shaft, which is mounted on two self lubricated bearings carried on a frame that is incorporated with the bed plate. This frame also carries the wheel case, the governor and the jet pipe. Within the castiron bed plate there is formed below the wheel a rectangular funnel, which leads the discharge water from the turbine to a horizontal steel pipe, 4 feet 8 inches in diameter and 33 feet in length. The velocity of the escaping water is nearly 600 feet per second, and at the outlet a baffle plate serves to maintain a certain depth of water which forms a deadening pool to break the velocity of the jet when it is diverted beneath the wheel at the time of sudden removal of the load. The water is led to each turbine by a 10-inch cast steel pipe provided with a manually-operated equilibrium valve. The jet pipe has a nozzle of tempered steel, and the water discharged is regulated by a steel needle which moves in the axis of the jet pipe. A cast steel deflector, placed between the nozzle and the bucket wheel, is raised or lowered by the action of a governor, and when it is lowered it causes a deflection of the jet water from the buckets.

The tests of the installation show that it has a maximum efficiency of 82.3 per cent. It is an interesting fact that the power absorbed by the wheel (whose periphery runs at over 200 miles per hour) to overcome air friction alone was nearly 150 horsepower, or 5 per cent of the normal power. It is noteworthy also that when a load of 3,300 horsepower was suddenly thrown off the turbine, the increase in speed was only 3¼ per cent. For the photographs of this plant and the details regarding its construction, we are indebted to *Engineering* and the Hydroelectric Department of Vickers, Limited.

Air Tight Storage and Dry Heat, New Pest Controls

THE ridding of grain of insect pests, through a simple process of hermetical sealing, and the control of seed borne diseases of various grains through application of dry heat, are two fields of investigation in which agricultural workers have recently made progress.

In England, the Grain Pests Committee of the Royal Society has published experimental evidence of a very favorable nature, drawing the conclusion that air tight storage is probably the best method of preserving grain and cereal products from insects or mites. The procedure followed in experiments was to take a sample of infested grain, hermetically seal it, and through a variety of tests incorporating different temperatures, different pests, different lengths of treatment, and small and large air-spaces, arrive at a conclusion respecting both the limitations and the possibilities of the method.

Wheat badly infested with mites was freed by sealing for 24 hours at 75 degrees to 80 degrees F. Sealing for 7 days at 84 degrees to 87 degrees F cleared of infestation flour heavily infested with larvæ of E. kuhniella. Wheat infested with larvæ and eggs of Calandra oryzae was cleared at 75 degrees to 80 degrees F in 28 days, with larvæ and eggs of C. granaria at the same temperature and period, with larvæ and pupæ of C. oryzae at 88 degrees in 25 days. Air-tight storage of Indian wheat for 23 days at 88 degrees F cleared the sample of Rhizopertha dominica. This sample was afterward kept in room temperature for nine weeks, but remained insect free.

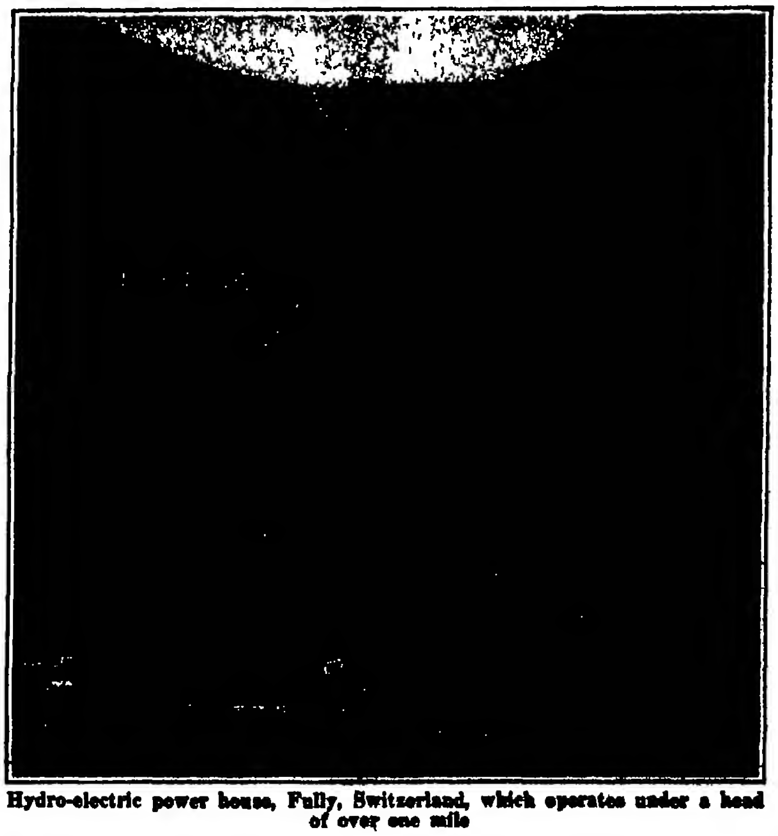
Still other experiments were made with favorable results. It had been urged against this process that it might be accompanied by the process known as "heating." *In order to have a conclusive test on this point,* the grain used, sealed in thermos flasks, purposely contained excessive moisture. Not only did no "heating" result, but the method was also found to prevent the growth of molds. Owing to the exaggerated moisture the wheat became acid, but the authorities state there *is no reason for thinking this would occur* in normally dry grain.

The control of seed borne diseases in grain is reported on in an official American publication. This is a subject naturally of most interest to farmers and seed dealers. The experiments with dry heat were rendered particularly important because of certain seed borne diseases which do not yield to the ordinary chemical and hot water treatments.

These diseases include bacterial blight of barley, bacterial blight of oats, wheat scab, spot-blotch of barley, net-blotch and stripe disease of barley, and Helminthosporium blotch of oats. It was found that bacterial blight of barley and bacterial blight of oats can both be eliminated by exposing the infected seed to dry heat at temperatures which leave the seed still viable.

A number of seed-borne fungous diseases, including wheat scab, primary infections only, and spot-blotch of barley, are practically eliminated by the dry heat treatment as used. Striped disease of barley, loose smut of barley and smuts of oats, are markedly reduced by dry heat without inflicting material injury to germination.

Experiments appear to indicate that barley, wheat, rye and oats, especially when of good quality and well-dried, are able to withstand long-sustained exposure to dry heat at relatively high temperatures.



Hydro-electric power house, Fully, Switzerland, which operates under a head of over one mile

Shutting Out an Eyesore

TO hide the unsightly appearance of a building under construction a Los Angeles architect devised the unique idea of building an ornamental fence around the entire structure that was entirely out of the ordinary The outline of the fence in places was built to resemble the roofs of California bungalows and the painter completed the bungalow with his brush, working in the windows, pillars, vines and trees and people in the windows. Parts of the fence were also used for advertising, with a lot of clever art work, the whole scheme being to make a beauty spot out of what otherwise would have been a neighborhood eyesore

The Shock Loader

A MECHANICAL shock loader which can be driven down a row of corn or small grain shocks, pick up the bundles and elevate them into a rack driven alongside, is shown in the accompanying illustration It is used to a considerable extent in the spring wheat country of the Dakotas and Canada where it saves a great deal of labor in threshing The principle of the machine is similar to that of the hay loader, except that the bundles or shocks are picked up at the front instead of at the rear

A New Track-Laying Device

OUR cover this week shows a special machine for laying and lifting track, recently perfected It consists of a structural steel frame for placing on a standard flat or logging car This frame carries on an upper deck a two-drum engine to operate a load line and a "traffic" line Two cars hooked up with a locomotive, the machine car ahead and the tie car next to the locomotive, comprise the equipment ready for work The trolley track is constructed of two channels riveted to form a strong girder with the flanges forming a track for the trolley carriage to traverse. The trolley track is constructed in three sections and is attached under the upper deck so as to provide clear passage for the carriage throughout its length.

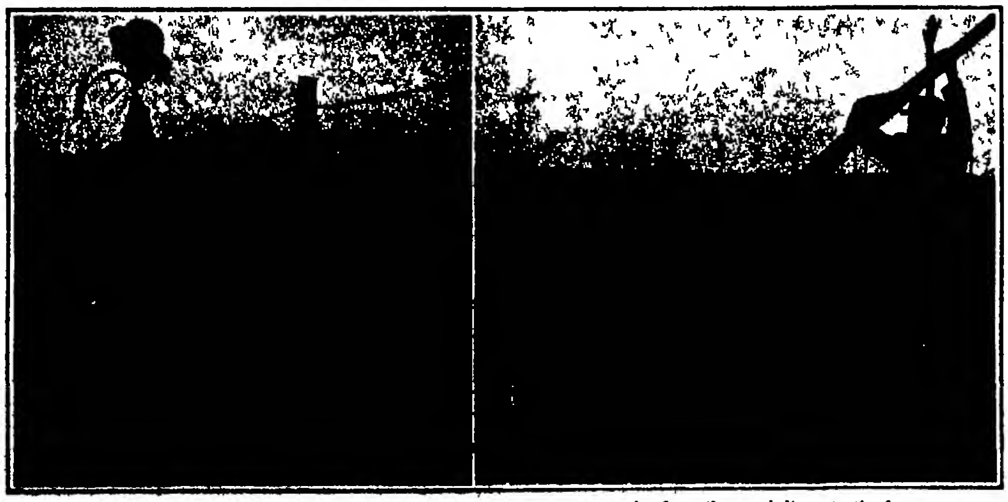
The machine is built for lifting a maximum load of 4,000 pounds at either extreme end of the boom and for carrying the load either way the full length of the boom. The normal hoisting speed of the load is 100 feet per minute, and the normal speed of the carriage traversing the boom is about 200 feet per minute. The capacity of the equipment for the load of rails and ties depends upon the carrying capacity of the cars used and upon the railroad track. There is ample space in the machine for carrying 150 sixty-pound rails, still leaving sufficient room to pass a bundle of 15 ties through the machine In practical use an average load with ordinary equipment is sufficient rails and ties to lay a quarter mile of track

The machine is also used in placing bridge structures. The boom reaches out far enough to place sills, caps or complete bent if the bridge is constructed that way The timbers or stringers are picked up with the machine from the side of the right of way, carried on the rail car or the tie car to the bridge and lowered to the exact spot desired

The "bungalows" and the advertising sign are alike parts of the wooden camouflage of a big building operation

Saving labor at threshing time with the shock loader Machines of this kind are used to a considerable extent in the spring wheat country of the Dakotas and Canada

How two continental shop-keepers have made the most of their inability to get plate glass for their front windows



Left: A modification of the milk cart in use as a means for unrolling wire from the spool direct to the fence
Right: An effective post-puller

Speeding up the business of fence replacement

"Ersatz" Window Dressing

WINDOW dressing it might appear, is dependent entirely for its effects upon the presence of a real window, a sheet of plate glass filling the entire space between the door and the corner of the building In parts of Europe, however, plate glass has been destroyed on a much larger scale than that on which it has been replaced The ingenious seeker after show effects is then obliged to turn his imagination into new directions, and evolve a display which shall not call for the full window We illustrate the manner in which two continental shops have solved the problem. One of them has replaced the single sheet of the unobtainable plate glass by a number of panes of ordinary window glass, and has succeeded in designing the frames of the latter in such a way as actually to attract, rather than to offend, the eye On and behind these panes we see the customary signs and display of wares. Another has taken the bull more boldly by the horns and substituted a large ornamental sign for the window, leaving only a few panes of glass at the top for illumination

Tools for Fence Makers

TWO handy devices to be used in fence making and tearing down are shown in the accompanying photographs The one is an attachment to the milk cart for unrolling wire from spools and the other a device for pulling posts. In the former a steel rod is placed through two wooden uprights and supports the wire spool Any farmer could easily make a cart for this purpose if he did not have one already in use The post puller is simply a long lever mounted on two wheels near one end with a hook attached which is fastened to a chain wrapped around the base of the posts. The wheels act as the fulcrum of the lever and should be heavy enough to support a rather severe weight, for a tremendous leverage is secured

Science Coming Into Its Own

The National Research Council and Other Research Organizations and Some of Their Achievements

By Charles Frederick Carter

EVERYBODY today is impressed in an abstract way with the value to industry of scientific research, and through industry of its value to the nation at large It is not always so clear that scientific research pays direct dividends to the person who meets the bills; and for this reason there is a fairly definite tendency to leave it to the other fellow Plenty of big business concerns are in a position, to be sure, where they are obliged to endow extensive research activities, but as many others fail to do this because they are not actually forced into it by circumstances What is everybody's business used to be nobody's business, today the proverb is altered, and everybody's business becomes the Government's business In this article Mr Carter tells us about one of the most effective agencies of Governmental supervision of scientific research that has yet been devised —THE EDITOR.

THIRTY million dollars as nearly as can be ascertained will be expended in scientific research for the further development of agriculture, engineering and the industrial arts in the United States this year Of this investment in brains one-third will be contributed by the National and State Governments, the other two-thirds by private enterprise

While scientific research was begun some years ago no less an authority than Dr J R Angell, who was chairman of the National Research Council and who is now president of Yale University is responsible for the assertion, made two years ago that "research in industry is astonishingly backward (in America) as compared with Germany and even with England"

It is one of the ironies of fate that a nation so little inclined to war, so given to industrial self-complacency, as the United States should owe so much to war as a stimulant to the scientific development upon which industrial progress is built. Yet history records that Lincoln requested the creation of the National Academy of Sciences to help solve problems vitally affecting the conduct of the civil war and that more than half a century later Wilson asked that the organization founded on Lincoln's initiative should be expanded into the National Research Council to assist in mastering the technical difficulties encountered in the conduct of the greatest of all struggles. It is directly due to the efforts of this National Research Council that the activities of scattered research agencies have been coordinated and given fresh impetus pursuant to former Chairman Angell's position that "It is essential that we conceive of research as the organized technique of science itself, working for its own propagation"

Now that this great organization, embracing some forty scientific societies with memberships running into the thousands, is becoming more fully readjusted to peace conditions it promises to exert a more potent influence on industrial progress than it did on the conduct of the war and that is saying much Science is indeed, coming into its own

The National Research Council may, perhaps, aptly be characterized as the General Staff in command of the Nation's industrial army in its advance into the Unknown Continuing the military simile there are several hundred divisions, each consisting of a research laboratory maintained by some industrial corporation with a staff ranging from a score to some hundreds of technologists in charge of a director of research and each devoted to the particular lines of investigation and development in which its employer is interested Strange as it may seem not even the National Research Council has been able to make an accurate and complete census of the research laboratories and forces in America, but it has been able to list approximately three hundred such laboratories.

An indication of the importance attached to this new research organization is to be found in the fact that the Carnegie Foundation has made a grant of $5,000,000 for a building and an endowment for the National Research Council The permanent home of the council is to be in Washington Further recognition has been given by the Rockefeller Foundation which has made a grant of $500,000 to be expended within five years to promote fundamental research in physics and chemistry at educational institutions in the United States and to found fifteen or twenty research fellowships.

As a final impressive recognition of the important part science is to play henceforth in shaping the destinies of the Nation the Government designated Dr C S Howe of the Case School of Applied Science as Scientific Attache to the American Embassy at Paris—the first scientific attache, by the way, in the American Diplomatic Service

The activities of the National Research Council will be as broad as the needs of man For example, it has under consideration a nation-wide investigation of reforestation, such as no single agency could handle No comment is needed to demonstrate the urgent call for such an investigation and for the prompt application of all the knowledge that may be acquired, for it is notorious that unless present practices are quickly curbed our forests will be utterly destroyed

Another wide problem calling for study on a most extensive scale is the adaptation of soil fertilizers to different regions. Because newly cultivated fields in many parts of the country were almost unbelievably fertile farmers have too generally proceeded on the theory that the riches which Nature had been storing in the soil for ages never could be exhausted Now the truth is all too plainly evident that if the country is to be fed science must be applied to agriculture.

Research in industrial arts is separated into seven divisions representing science and technology It should be understood that the National Research Council does not itself undertake all the numberless investigations that are needed Rather it undertakes to coordinate the work of others, to disseminate available information, to act as a sort of clearing house through which investigators widely separated and unknown to each other can be of mutual assistance It has often happened that men have worked weary months, perhaps with indifferent success, on an investigation that had already been thoroughly carried out by others, because the results of such work were not available in the libraries within their reach The Division of Research Information, therefore, will by no means be the least important bureau of the National Research Council

The greater part of scientific research in industrial arts will continue to be carried out by private bureaus. Perhaps the largest, most highly developed and best known of these private research laboratories is that of the General Electric Company at Schenectady, N Y, occupying a seven story building with 66,500 square feet of floor space This building was erected for purposes of research and so is unusual in equipment. Special pipe galleries accommodate pipes for hot and cold water, distilled water and just plain water There are pipes for compressed air, for vacuum, for wires for various kinds of electric currents. There is a liquid air plant with a capacity of five gallons a day and there are electric furnaces capable of producing extremely high temperatures

The staff consists of Dr Willis R. Whitney, who has been director of the laboratory since 1904, and who as a member of the U S. Naval Consulting Board and of the National Research Council during the war, rendered distinguished services to his country, 2 assistant directors, 50 chemists, 12 physicists, 13 engineers, 50 research assistants, and machinists, glass-blowers, electricians and clerks to the total of 225.

Research here covers a wide range, including electrochemistry, physio-chemistry, metallurgy, electric insulation, electric furnace products, lamps, and alloys, rectifiers, heat insulation, furnace products, wireless telegraphy and many other things. Things that seem queer to the layman are done in this big laboratory For instance there is a "bug farm" where a cereal beetle which is becoming unpleasantly frequent in flour, oatmeal, and many other food products is bred by thousands for experimental purposes. The investigators were seeking a way to kill the eggs before they could be hatched, with a view to preventing the waste of the flour or other food products. It was found that X-rays were effective.

Many problems in pure science are studied, such, for example, as the structure of the atom The General Electric Company has no idea what it would do with the information if it had it. Indeed it is no unusual thing for a member of the scientific staff to pursue a line of study for months without any idea of where he is going or what he will do when he gets there; This is in line with the settled policy of the company; for experience has taught that a given investment in brains will yield dividends as surely as an investment in a gilt-edged security It is accepted as an axiom at Schenectady that there is no scientific investigation, however remote from industry, which may not possibly lead to industrially useful developments.

"It is rare," says Dr Steinmetz, "that sooner or later some industrially valuable results do not follow, no matter how abstruse or remote from apparent utility a scientific investigation may appear"

For example, no immediate or direct benefit to the General Electric Company could be foreseen when the consulting engineering laboratory undertook an elaborate research on the electrostatic corona and dielectric phenomena in general. The investigation was assumed to be justified on the ground that greater knowledge of these phenomena might extend the economic limits of long distance power transmission and thus increase the market for transmission appliances. But before the research was completed it led to the redesign of practically all high voltage transmission apparatus and thus amply justified the undertaking.

The Westinghouse Electric and Manufacturing Company maintains a research staff which ranks among the half dozen foremost The director, C E. Skinner, and staff of 132 engineers, chemists, physicists and assistants have five laboratories at their disposal, including a research building, in which investigations are conducted on lamps, incandescent solids, luminous gases, magnetic materials, photomicrography, metallurgy and photometry, conductivity of metals, linear temperature coefficients and electrical insulation.

The laboratories of the Western Electric Company are functionally a part of the engineering activities of the whole Bell Telephone System They include a physical, a chemical, a transmission and a physical testing laboratory employing a total of 925 chemists, physicists, engineers, designers, draftsmen and assistants. The problems studied in the chemical laboratory relate to magnetic and non magnetic materials, preservation of timber, very thin and high-grade papers used in telephone condensers and kindred subjects. The physical laboratory is equipped for fundamental research in all problems relating to telephony, telegraphy and signaling on land or sea.

The E. I du Pont de Nemours Co. employs a research staff consisting of a director, 400 graduate chemists and engineers, and assistants and workmen to the total number of 1,189 in four laboratories scattered in three states on problems relating to the manufacturing operations of the company, including miscellaneous chemicals, dyes and intermediates, explosives, coated fabrics, plastics, pyroxylin solutions, lacquers, paints and varnish and the production of miscellaneous raw materials, such as mineral acids and nitrates of soda

Another research staff ranking among the half dozen foremost is that maintained by Wilson & Co., packers of Chicago, consisting of a director and ten assistants studying problems connected with fermentation, spoilage, hydrogenation of oils, refining and handling of oils and by-products. The Eastman Kodak Company has a research staff of a director and 40 chemists, physicists and photographic experts with 30 assistants studying the theory of photography, new photographic materials and theory of manufacturing processes. The National Aniline and Chemical Company maintains a research staff of ten chemists which devotes its entire time to the study of problems relating to dyes and intermediates.

The foregoing will give some idea of the extent to which research is now conducted in the industrial arts and perhaps an inkling of the nature of some of the problems. Altogether there are now about five thousand scientists and assistants employed in research by manufacturing corporations. Their investigations cover practically the whole range of materials used in manufacture and the resultant products. The value of their labors is beyond calculation; the tungsten lamp alone has saved the country $100,000,000.

Weapons at Sea

The Place of Aircraft and the Battleship

By Commander E. G. Allen, U. S. N.

A WEAPON in war, theoretically, depends for value upon its armament, protection and mobility, and, for practicability, given an employment of it, upon its destructive power, the ease and economy of its employment, and the relative protective measure afforded while using it, compared to the relative protection which can be used to frustrate it or stand up under its blows

In new departures in warfare, and with new weapons, the offense is normally developed, initially, at a rapid rate compared to counter-protective measures. In wartime this is largely due to secrecy and the tremendous energy put into the design, production and employment of the new weapons; while in peace time, inertia, conservatism, and lack of vision with respect to new developments, produce the same effect. *Disaster in sight* is what quickens the vision and produces the energy to enable defense to obtain rapid development. So, it usually occurs that, given disaster ahead, defense is accelerated and eventually catches up Its rate of overhead depends, in peace time, upon the vision, energy, and persistence of the responsible officials, and, in war time, upon the urgency of the necessity—at home, upon the inventiveness, money, and available production facilities, and, in the field, upon strategical dispositions and the tactical ingenuity of leaders.

This is applicable ashore and afloat and has been the history of development in all warfare We may assume that with the first development of the stone axe and the bow-and-arrow by prehistoric man, rough helmets and shields appeared almost simultaneously, and in later periods as lance, sword, and cross-bow came into existence, chain armor and similar defense paralleled the offense

In the late war, such developments as the submarine, tank, gas, and machine gun, and massed artillery with explosive shell and gas, caught the defense lagging materially and tactically Aircraft came as a distinct innovation and the defense is still not perfected materially or tactically ashore or afloat Aircraft if counter air defense is neglected, has under the theoretical value of a weapon, namely *armament, protection* and *mobility*, tremendous values. As *armament* it can carry gun, bomb, or torpedo while *protection* is assured by operating at will in a medium heretofore not used by man in war, and its *mobility* is the greatest yet achieved by man in a weapon

This feature, the retardation of defense development in peace, was illustrated by the status of the submarine in the late war Great Britain, with a huge sea commerce, her home government centered in a small island, located near probable enemies, and dependent for existence on sea-borne commerce, had lacked ordinary foresight and vision in perfecting her submarine defense Similarly, the underwater protection of her capital ships had lagged behind torpedo development Necessity in war compelled her to perfect this anti submarine defense in two years

The initial destruction wrought by the submarines tremendous in its effect, brought the usual storm of fanaticism relative to the value of the submarine as a weapon In this country a serious move arose to intrust the entire national defense at sea to the undersea boat. The submarine has now, in a large measure, found its place, its proper value and its limitations are recognized Defense against it is to a great extent perfected materially and tactically It is almost beyond a possibility that in a future war the defense could lag to such an extent that the submarine should be the determining factor of the war

The advantage gained by the submarine is not in a new armament, but in the relative protection it secures from invisibility in approach attack, and getaway Absolute cover from vision is its prime asset

Aircraft has not this advantage its primary asset being mobility, rendering surprise easy Aircraft will employ no new armament and the defense is given the same old problems, namely, to combat bombs, torpedoes and gas fire, when used with great mobility in war The defense at sea against aircraft is an easier problem than submarine defense, because aircraft is not invisible It is both visible and audible, and defensive measures can be positive in that the attack is located and fixed by vision and sound

By water tight subdivision and armor, the capital ship already has in a large measure protection against the weapons enumerated, namely, bomb and torpedo and can be made immune by simple arrangements against gas With the addition of more horizontal or deck armor, the aircraft bomb can be discounted as a serious weapon against such armored ships. Against merchant vessels, destroyers, light cruisers, or plane carriers, the aircraft bomb has a case

Counter-air-defense is, logically, the major counter against air attacks and anti aircraft gun defense is the secondary counter Afloat, anti-aircraft guns should be of more value than ashore for the following reasons *Afloat*, the battery is always at the scene of the object to be protected *ashore*, the anti aircraft defense is usually spread out to cover a line. Once over this line, the bomber drops his bombs at leisure unless the object to be bombed has additional local defense

At sea, there is, over each particular ship, a limited vertical rectangular area bounded by the height and speed of the bombing aircraft in which such aircraft must be to hit the ship If not in this area when dropped the bomb misses Counter air fixed-barrage can be adjusted to keep high-explosive shell bursting in this area, rendering bombing unsafe and difficult This secondary defense must of course, be supplemented by a major one employing protective pursuit planes These combined defenses, properly organized, should render a fleet practically immune from bombing

The torpedo plane however is a more serious weapon than the bomber due to its greater flexibility for tactical purposes—torpedoes can be released at various ranges and on any bearing—and due to the fact that

(Continued on page 33)

A Chat with Madame Curie

What the Discoverer of Radium Thinks of Us and What We Think of Her

By Austin C. Lescarboura

THAT virtually impenetrable barrier placed about Madame Curie since the very day of her arrival in New York City and resolutely maintained against repeated but futile onslaughts of press photographer newspaper reporter, special writer and technical journalist alike, was removed for a few hours on the eve of her departure for France All our previous efforts to reach the discoverer of radium were absolutely wasted. But on June 24th, the day prior to her sailing on the "Olympic" with her precious gram of radium, Madame Curie granted us an interview at the home of her hostess, Mrs Meloney, in New York City

First of all, let us hasten to assure the gentle reader that Madame Marie Sklodowska Curie is not one who would set herself apart from the public. This matter of refusing to grant interviews and pose for almost countless press photographers was not one of her own choosing. It was an imperative measure arising out of her poor state of health. And when it is borne in mind that the workings of the modern press and news picture machinery are such as even to wear out robust persons, we can readily see the justice of the barrier thrown about Madame Curie

She carries honor and fame gracefully, this wonderful woman. For despite the fact that Madame Curie had fifty-five degrees from numerous universities, colleges, laboratories and other institutions before coming to this country, to which must be added ten more degrees conferred upon her by American universities and colleges during her seven-week sojourn in these United States, Madame Curie remains—and always will remain—just plain Madame Curie.

Unassuming, plainly but neatly dressed, womanly and motherly in appearance, yet keen when the conversation swings to scientific matters, speaking a delightful English that is flavored by what may be a trace of her Polish birth and a good bit of French, her adopted mother tongue—that, in brief, covers the outstanding features of Mme. Curie as we saw her, questioned her, listened to her for upward of an hour

Before going ahead with Madame's little talk with us, it may be well to run over the major details of her all too-brief stay in America Madame Curie came here from France on May 11th last in order to receive a gram of radium—the gift of the American women in recognition of her services to science and humanity The gram of radium was presented to her by President Harding on May 20, 1921, at the White House Between May 11th and June 25th, the day of her departure, Madame Curie visited most of our leading universities, colleges laboratories, Government bureaus, cities and natural wonders

As already stated, ten degrees were conferred upon her in recognition of her contributions to science and humanity Smith College conferred the degree of Doctor of Science Doctor of Medicine was conferred by the Woman's Medical College, the University of Pittsburgh conferred two degrees, Doctor of Science and Doctor of Laws, Yale, Columbia Chicago, Northwestern, and Wellesley conferred Doctor of Science, and Doctor of Philosophy came from the University of Pennsylvania

Aside from honorary degrees Madame Curie received numerous other distinctions. Thus the Philosophical Society awarded her a gold medal, which carries a money award of $800 The Naples Table Award of $2,000 also went to Madame Curie, as well as the Willard Gibbs Medal for scientific achievement which, it is said, has never been awarded to any other woman This famous scientist was also made Fellow of various technical societies. But despite it all, she remains just plain Madame Curie, working for the good of humanity and for the expansion of scientific knowledge

Madame Curie likes America—who wouldn't? She was highly impressed by what she saw and heard at the various American universities and colleges which she visited. While not willing to commit herself to a definite statement regarding the relative merits of European and American institutions of learning Madame Curie believes that we have excellent facilities for training our youth for every line of endeavor The girl colleges pleased her immensely, and she commented most favorably on the fact that many of our girl colleges Bryn Mawr, Vassar Wellesley for instance—are located in the country, which is more conducive to good health and quiet study But greatest of all in Madame Curie's opinion, are our free institutions of learning, especially in such centers as New York City, where the lack of financial means need not necessarily stand in the way of the ambitious boy or girl desiring an academic training

Both from within and without, we Americans have got into the habit of believing that little we do is done for anything else than to make money But our dollar chasing habits have been grossly exaggerated, so it seems. For we asked Madame Curie if she found our scientific laboratories interesting and she replied that she did Following that, we asked, in a somewhat abashed way if she thought we were contributing anything to science, instead of taking science and molding it into the ways of industry for the pure and sole purpose of making money

Here is the answer startling, to be sure, but nevertheless true Madame Curie believes that much of the work done in our leading laboratories and universities is done for the sake of science—pure science—and does not contain the slightest trace of industrial motives. Our Government laboratories are doing wonderful work in many different directions for the good of science and humanity at large, and with the dollar sign conspicuous by its very absence Truly, we are not the money grabbers or dollar chasers that we have been made out to be by others as well as in our own minds

Still, there is something wonderful about our industrial prowess. Madame Curie was delighted with our development of the radium industry, indeed, we have

(Continued on page 35)

Three interesting lightning effects, as recorded by the "still" camera specially adapted for this sort of photography

Lightning

A Brief Statement of Its Nature, with Some Figures and Some Photographs

By Jerome Lachenbruch

OF all natural phenomena lightning is one of the least understood In school many of us were taught to believe that lightning is caused by one cloud striking against another In other words, the suggestion that lightning is a form of frictional electricity was firmly implanted This is a far-fetched truth The element of truth resides in the fact that lightning is the result of an accumulation of static electricity and suddenly discharging, and frictional electricity is also a form of static electricity An explanation of the various phenomena that result in lightning takes us back to a simple discussion of static electricity at rest in contradistinction from electricity in motion

Every substance is composed of electric charges, both positive and negative These tend to neutralize each other But if a substance were to receive positive electric charges from another body, the first would change its polarity and become a positively charged body This change in polarity occurs whether the charge received be positive or negative Such additional charge may be given off to another substance or to the earth itself The earth is known as a neutral body, a sort of reservoir for all electric charges It receives and gives off both positive and negative charges according to the needs of substances on or near its surface to attain an electrically neutral state And it is the tendency of all substances to achieve this neutral condition

Another phenomenon that must be borne in mind is the fact all electric charges tend to seek the surface of a substance For example, if you charge the inside of an iron ball you will find that the outside surface is also charged Carrying the idea into the realm of the clouds we find that clouds being composed of rain drops, are charged electrically Each raindrop contains its own charges and when trillions of them coalesce to form a cloud the total number of charges on the individual drops remains the same, but they are compressed into a comparatively small area. Consequently, the potential of the cloud as a unit rises and a powerful charge becomes concentrated Now, when this cloud sails over the earth's surface it discharges its electric load into the earth with a brilliant flash That is lightning The flash breaks through the air pushing the particles of matter out of the way with tremendous force, and after it has passed the air closes about the path made by the electric current This pushing away of minute substances and the closing in behind the flash causes the roaring sound of thunder

Lightning occurs not only between various objects on the earth, such as trees and a cloud, but also between two clouds of different potential Discharges occur, too, from a lower to a higher stratum, and often rain will discharge a cloud silently In such cases the lightning ceases with the rain In all cases, however, thick dense clouds serve as conductors of electricity And as we know that dry air is a poor electrical conductor a discharge cannot take place unless there is a ladder of moist air between the earth and a charged cloud or between two clouds

From the layman's point of view, there are two main kinds of lightning, forked lightning and sheet lightning Forked or chain lightning may be a mile or more in length and usually descends in a zig zag course Sheet lightning is but the reflection on the sky of distant electrical discharges.

Sir Oliver Lodge distinguished lightning into two distinct types which he named the A and the B flashes. The A flash occurs, according to Sir Oliver Lodge, when an electrically charged cloud approaches the earth without an intermediate cloud intervening In this condition, the discharge takes place directly between the cloud and the earth The B flash, however, occurs when another cloud intervenes between the cloud carrying the primary charge and the earth The two clouds then form a condenser, and the discharge from the first takes place into the second Now the free charge on the earth side of the lower cloud is suddenly relieved, and a discharge from the latter to the earth follows. But it takes such an erratic course that no known lightning conductors are an adequate protection against it.

The accompanying photographs and others of the same sort are the result of a technique developed at the Dominion Astronomical Observatory in Ottawa, Canada, and applied chiefly by the U S Weather Bureau and the Mt. Wilson Observatory, as well as by the Canadian meteorologists. With them as a background the story of lightning has been animated so that the actual flashing of the various kinds of lightning may be seen on the motion picture screen. An interesting phenomenon, not visible to the naked eye, sometimes occurs in such photographs in the registration on the sensitive photographic plate of black streaks known as the Clayden effect. This has rarely been successfully photographed

If the meteorologist is interested primarily in the cause of lightning another type of scientist will deny contentment until he knows the various quantitative data with reference to the flash Dr Steinmetz, in a recent interview, supplies some of these He estimates the difference in potential between the cloud and the ground, or between the two points of discharge in the clouds, to be no less than 50,000 000 volts. The current in the flash he states as 10,000 amperes. Both these values, of course, are averages and may be materially exceeded by individual flashes, which may likewise fall far short of the figures stated But in spite of this tremendous voltage and amperage the actual power value of the flash is comparatively small because of the extremely short duration Dr Steinmetz estimates this factor at 50,000 kilowatt-seconds, or less than 2 of the kilowatt-hours that we find charged for at current rates on our lighting bills at the end of the month So if we could catch all the current of an electric flash and put it to work under conditions the most favorable to its usage, it would be worth only sixty or seventy cents Mr Steinmetz points out that our impression of the duration of the flash is not at all to be relied on If it is bright enough to be seen at all, it must of necessity, by the principle of visual persistence familiar to all movie fans, look to us just as it would look if it lasted one-tenth of a second. Indeed, when it is of extreme brilliancy, the effect of dazzlement is added to that of ordinary visual persistence and we are convinced that the flash lasted for several seconds. This is seldom, if ever, in accordance with the facts; Dr Steinmetz sets .0001 second as the duration of the flash, and any student of electricity will realize that this must be substantially correct. Flashes of much longer duration must ordinarily be of low potential, though of course there is no absolute limitation to the duration of high pressure lighning

Sewage Disposal in the Country

A SYSTEM by which an isolated dwelling (or small group of buildings) having running water may dispose of sewage safely and at small cost is recommended by the U S Public Health Service

The chief feature of the system, which has been in successful operation in New Hampshire for summer cottages and hotels for ten years, is a rectangular septic tank, of concrete, with a minimum capacity of 94 feet. This will serve 20 people; four cubic feet additional should be provided for each additional person.

The tank should be buried under 12 to 18 inches of earth, as near as practicable to the house, with which it should be connected with piping. The effluent from this tank, which contains organic matter that might be objectionable and even dangerous, is commonly best disposed of by some sort of subsurface irrigation whose exact form will necessarily be governed by the nature of the soil Full details are given in the report.

Before installing such a system, however, the State health authorities should be consulted, especially in the limestone sections of the country, where care is necessary to prevent the contamination of springs.

Bombing a U-Boat

WE referred in our last issue to the fact that the first attempt to sink the ex-German U-boat "117" by aerial bombing was successful, and this week we present a photograph which is unique for the fact that both bomber and bombed appear in the same picture. This was rendered possible by the comparatively low altitude at which the bombs were released, together with the considerable stretch of water which separated the photographer from the target, and probably by the use of a telephoto lens.

The sinking of this U-boat, which, by the way, was one of the later German submarines, was done in sixteen minutes, and the craft now lies on the bottom at a point sixty miles off Hampton Roads. One flight of three "F-5-L" planes sunk the submarine, using twelve bombs in the course of two attacks. The first attack took place at 10 23 A. M., when three ranging bombs were dropped, none of which made a direct hit but all of which registered close to the mark. After passing over the target the three planes returned for a second attack, when nine bombs were dropped from an altitude of approximately 1,200 feet. One of the nine made a direct hit just aft of the conning tower, and the eight other bombs dropped within a very few yards of the vessel.

The first attack with three bombs was made at 10 23 A. M. The second attack was timed at 10 32 A. M., and at 10 38 A. M, the bow of the submarine submerged, the boat sinking steadily until shortly thereafter the conning tower went under and the boat disappeared altogether at 10 39 A M

The experiment proves that a single 163 pound bomb if it makes a fair hit on the deck of a submarine will sink her. The fact that only one out of nine bombs scored a hit at the comparatively low altitude of 1,200 feet suggests that if bombing attacks from the air are to be successful they must be carried out at moderate elevation, certainly not above 4,000 or 5 000 feet. The airmen, of course, in the present case had every thing in their favor. There was a calm sea, little if any wind, and there was no defense by the customary anti aircraft guns. Against the much larger target presented by a battleship or a cruiser more hits would doubtless have been recorded than one out of twelve. On the other hand, it is probable that several of the bombs which failed to hit the target, detonated in the water so close to the U-boat that the concussion would have opened her seams and sent her, if more slowly, to the bottom

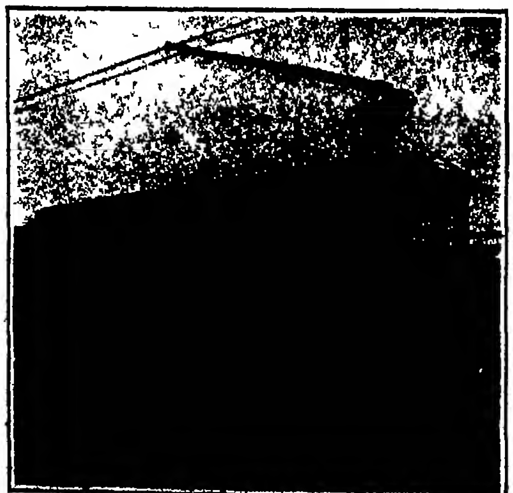
Re-Introducing the Trackless Trolley in the United States

A DEMONSTRATION of the trackless trolley bus was given recently at the Schenectady plant of the General Electric Company before a large number of prominent street railway officials and engineers

A double trolley wire necessary for this type of car was strung up over a route of about ½ mile and the visitors spent most of the day riding back and forth in the car, examining the mechanical features and testing the apparatus. The demonstrations were declared in every respect successful

The tests took place previous to the placing in service of a number of these cars in Richmond, Va, which will be followed by installations in other cities

The trackless trolley car resembles in general size and appearance the present one-man safety car and seats 30 passengers. The equipment consists of suitable railway motors and a controller arranged for foot operation



One-man trackless trolley car constructed for use in Richmond, Va.

At the top of this view are three airplanes whose bombs are seen detonating upon and around U-boat 117 below

Two overhead trolley wires supply the current which is taken into the car by a sliding type collector, maneuvered by the motorman from his seat. This arrangement allows a leeway of 18 feet, or 9 feet on each side, for passing other vehicles. Furthermore, this allows two cars to operate in opposite directions on the same wire. The collector can be disengaged, swung off to the side, and reconnected to the wire after passing the other car

When running over the track area of the system, that is in returning to the barn, the trackless car is equipped with an adaptor on the collector for connection with the standard overhead, and a shoe which fits into the trolley track groove and gives the necessary ground connection.

The chief advantage of the trackless over the regular trolley system is the low initial capital investment. To install a single track trolley line on an unpaved street the cost is about $35,000 per mile. On a paved street, where the trolley company is forced to pay for the pavement between the rails and two feet outside, the cost jumps to $75,000 per mile. The overhead for a single trackless trolley costs approximately $4,500 per mile and where a double set of wires is strung the cost will be about $5,500 per mile

As compared with the motor bus the operating and maintenance cost is much cheaper. From the standpoint of the rider, it is claimed, it provides a service of equal reliability and comfort, and in many cases the operation is faster and smoother, especially where the streets are well paved and maintained. Comparing the operating cost with the motor bus, gas and oil cost on an average of five cents per mile, whereas with the trackless trolley the cost of electricity is but two cents a mile. The maintenance of equipment including tires, averages 9½ cents per mile for the motor bus as compared with four cents for the trackless trolley. Depreciation on the gasoline bus averages 3 4 cents per mile as compared with 1.0 cents for the trackless trolley. The saving in favor of the trackless trolley is therefore 10 cents per bus mile. Figuring that the average bus runs 35,000 miles per year, this means a saving of $3,500. The first cost of a trackless trolley installation is higher than a gasoline bus—due to the overhead construction required. Interest, depreciation and taxes on this investment reduces the annual savings from $3,500 to from $2,700 to $3,000 per bus in service

Trackless trolley cars have been in successful operation in some European countries for several years. One hundred miles of trackless system are in use in England and in Italy several companies are operating over 40 miles of route

Such cars are not new to the United States, but at present none are, so far as can be learned, in use. The general purpose of this car is not to supplant or take the place of the ordinary rail system for the business districts or thickly settled sections of a city, but to make it possible to operate trolley cars in suburban sections where the cost of laying and maintaining rails and ties would make the extension of lines impracticable

Barn Screens, Too

A LARGE dairy farm keeping pure breds and known for its excellent business management screens its barns—windows and doors—in summer just as diligently as ever any dwelling house was screened. An endeavor is made at the same time to keep the barn clean. The twin measures do a good deal to abate the fly nuisance, which at present production costs is a serious one in summer on thousands of dairy farms in this country

There is absolutely no question of the effect of discomfort on milk production. The cow pestered by flies gives less milk often markedly less. Dairy farmers now do various things to combat the fly nuisance, but usually a combination of measures is best.

Capping an Oil Gusher In Minutes to Save Thousands of Gallons of Oil

A GOOD deal has been said in the past about the enormous quantities of oil that are wasted year after year through the inability of oil field workers to control gushers. Following the successful drilling operations a good oil well sends up a heavy stream of oil which is blown high in the air, and quite obviously, some means must be employed to cap such a gusher in order to bring the oil supply under proper control

The accompanying illustration shows one of the several devices that are now being employed in the leading oil fields for the purpose of capping gushers in a minimum of time. Here we see an American engineer and his Mexican helper completing the task of bringing under control a big gusher in the Panuco River district of Mexico. The gusher was stopped in a few minutes, our informant tells us, and the waste of oil was negligible. The heavy iron pipe frame helps to hold down the capping member. The flow of oil is stopped by clamping a cap on the well pipe, following which heavy valves are put on. The valves then serve to control the flow of oil. One of the biggest gushers in that Mexican field was stopped in seven minutes with this device

Stopping the flow of an oil gusher by means of a capping arrangement

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Making Phosgene Safe

SEVERAL accounts have appeared in the literature relative to commercial uses of phosgene, numbered as one of the deadly war gases. At one time experiments were conducted, showing that it could be used to free sand from iron, but the method proved too expensive. Phosgene, however, does have important uses in our chemical industries, such as the manufacture of dyestuffs, but on account of its poisonous nature its shipment has been a problem, involving the use of such solvents for the phosgene as gasoline, benzine, etc. These liquids absorb about equal weights of the gas, but no excessive pressures are produced, hence shipments can be made in ordinary containers. When these are opened the volatile solvents and the gas evaporate, or if heated in suitable vessels the phosgene can be liberated in a manner facilitating its use.

Feeding Experiments

IT seems that the processes which have been developed and described for manufacturing cattle food from sawdust, in which a part of the cellulose is converted into sugars, have been based more upon laboratory experiments and theoretical deductions than actual feeding experiments. The Forest Products Laboratory prepared a sufficient quantity of the food to supply three cows for a sufficient time to indicate the desirability of conducting experiments on a larger scale. The Wisconsin Experiment Station cooperated in this work, and the results were so encouraging that it has been decided to feed a larger number of animals a sufficient length of time to reach definite conclusions. This will necessitate the preparation of a larger quantity of such food than has been available heretofore, and the final outcome will be awaited with unusual interest.

Manufacture of Carbon Dioxide

COMPARATIVELY little has been published concerning the production of this industrially important gas, associated in the popular mind with the soda fountain, although something over one hundred million pounds of liquid carbon dioxide are produced annually on this continent. Coal or coke is burned under steam boilers, producing simultaneously power required for purification and liquefaction, and flue gases from which the gas is obtained. The temperature of these gases is first reduced in a fuel economizer, then scrubbed to cleanse them, and then passed to an absorption system in which as much carbon dioxide as possible is combined with an alkaline carbonate. This carbonated lye returns through the heat regenerator before passing to the absorption system to renew the cycle. By such a system all heat is fully utilized. The carbon dioxide thus liberated from the boiling bicarbonate solution is separated from the steam as previously noted, cooled and compressed into cylinders.

Losses in Gasoline Motors

A. C. FIELDNER and associates of the Bureau of Mines some time ago undertook—in connection with investigations relative to the proposed vehicular tunnel to be driven beneath the Hudson, where the composition of exhaust gases is an important consideration—an investigation of the efficiency of gasoline motors. The work included analyses of the products of combustion with various types of automobiles, including loaded and light trucks at different rates of speed, and the close relation between the per cent of carbon monoxide and miles per gallon that might be expected was found to exist. Slight adjustments of the carburetor had an immediate effect upon the amount of carbon monoxide in the exit gases, and some cars were examined in which the incomplete combustion of the gasoline vapor resulted in a loss above 40 per cent in the possible efficiency of the fuel. It was shown that great care in carburetor adjustments will be repaid in increased mileage, and it was brought out in the discussion that the ideal carburetor would be one which would automatically supply richer mixtures for increased loads or increased grades, and leaner ones for less exacting duty. Research is in progress looking to the development of such a device. With it less than one per cent of carbon monoxide would be found in the gases, thus helping to solve problems of ventilation although it has been maintained by some that the toxicity of gases from internal combustion engines is not due wholly to carbon monoxide. It is understood that the gases involved would not necessarily interfere with the construction of a safe vehicular tunnel, since it would be possible to pump in air through passages at the bottom, allowing it to pass through perforations and to be drawn out through flues in the top of the tunnel. It is estimated that more than a million cubic feet of air per minute must be circulated, and this constitutes no small item of power expense.

Glass Containers

THE adaptability of glass as a container for many things now placed in tin is already the subject of considerable research. It is recognized that good materials in glass make a more attractive display and also permit the purchaser to be suited as to apparent quality. A new factor comes to light in the experience of a certain foreign importing company which found forty out of sixty five gallon cans of maple syrup to be minus the syrup upon receipt. Somewhere en route a small hole had permitted an industrious person to extract the contents. Glass may therefore become popular as a container which will be a preventive against thieving. The writer recalls the experience of a manufacturer of imitation maple syrup who in the old days came to a chemist, complaining that his product was being returned because it became black in the cans in which he shipped it, due no doubt to the action of materials extracted from the corn cobs used. This manufacturer had no objection to selling a substitute for the genuine article, but he did object to the action of tin upon his product and had not thought of using the obvious container—glass.

Colors for Glazes

SOME interesting experiments were reported last fall by J. D. Whitmer with glazes involving colors to be obtained by the use of nickel oxide. In general these glazes consist of the oxides of barium, potassium, calcium, zinc, nickel, aluminum, and silicon, with which magnesium, tin, or other oxides are used, the proportions of the various constituents being varied, depending upon the colors desired. The shades were reported to vary from blue green to grayish green shades, the grays being obtained from the oxide of nickel in the presence of magnesium oxide.

Lime—Its Properties and Uses

THE Bureau of Standards has issued a revised edition of its Circular No. 30, which is designed to give general information on the subject of lime, its preparation and uses. Of one hundred and sixty leading industries considerably more than one hundred use lime in some form or other. The circular gives brief descriptions of eighteen important chemical industries where lime is used, indicating where and how they use the material and the quantities required. A list of the tests usually applied to lime is given, including such items as chemical analysis, rate of hydration, plasticity, sand-carrying capacity, fineness, proportion of waste, time of set, and compressive strength.

Permeability of Rubber to Gases

THIS is the subject of scientific paper No. 387 of the Bureau of Standards in which the results of a series of tests are given, including data on the relative permeability of rubber to some of the common gases. The permeability to water vapor is high, being approximately fifty times the permeability to hydrogen. Taking the relative permeability to hydrogen as unity, the following figures are obtained for other common gases: Nitrogen, 0.16, air, 0.22, argon, 0.26, oxygen, 0.45, helium, 0.65, carbon dioxide, 2.9, ammonia, 8.0, methyl chloride, 18.5, ethyl chloride, 200.

Quantitative Determination of Vitamine

THE importance of this accessory substance thus far not isolated, but a known necessity to the maintenance and promotion of body growth, makes every piece of research upon the subject of value as possibly giving a clew to the ultimate composition of the material. When we have learned this we may perhaps find a way to isolate it and make it available for addition to substances which are cheaper and as nutritive as others and which differ from them principally in containing fat-soluble vitamine. R. J. Williams, in the *Journal of Biological Chemistry*, describes a method for the quantitative determination of the vitamine which prevents beriberi. A synthetic medium is prepared using cane sugar, ammonium sulfate, monopotassium phosphate, asparagine, calcium chloride, and magnesium sulfate. A sterilized portion of this material is mixed with some fresh, compressed yeast. After incubation for eighteen hours the growth is stopped by formaldehyde, is collected by filtration and, after washing with water and alcohol, dried for two hours at 108° Cent. and weighed. The yield of yeast in the medium containing the material being assayed for its vitamine content above that produced in the control experiment is a measure of the vitamine content of such a substance and is expressed as the number of milligrams computed back to one gram of the original material used.

Insect Powder

THE insecticide effects of common insect powder are due to a combination of acids and esters which first benumb and then kill insects which come in contact with it. It is not ordinarily harmful to the higher animals, but there have been recorded cases of a somewhat serious nature. Insect powder is derived from the flowers of certain species of pyrethrum and was known to eastern Europe more than one hundred years ago. It has been customary for the commercial product to be more or less adulterated with ground stems of the plant, and in the enforcement of the Insecticide Act the Bureau of Chemistry has found it necessary to evolve physiological, chemical and microscopical methods which are satisfactory for detecting adulteration. The results obtained are not accurate to a high degree, but a formula has been developed by which it is possible to approximate the amount of adulteration.

Ripe Olives

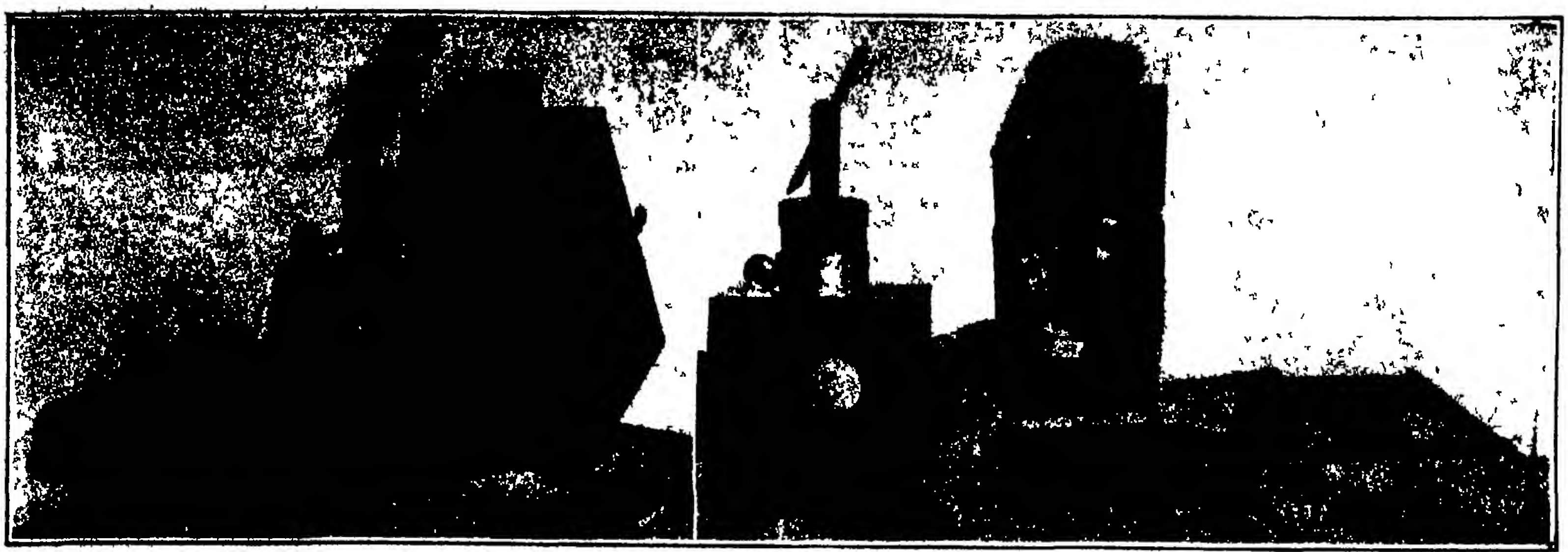
THE Bureau of Chemistry, investigating poisoning due to ripe olives, examined 2,161 commercial containers of which 560 were glass and the remainder tin. Collateral examinations in the case of 1,618 containers checked very closely with odor and appearance in determining the proper condition of the product. The toxic material examined was always sufficiently spoiled to be recognized by an offensive odor at the time the can was opened, and emphasis is therefore placed upon the responsibility of persons who open a sealed container of food and serve it to others before determining its soundness. Spoilage in any form should condemn the product. Bacillus botulinus was found in the material directly concerned in or taken from the pack that caused the poisoning cases during the year, and the serious contamination found was attributed to the practice of prefermenting the product by shipping and holding the olives in weak brine. All of these products were ultimately processed, but carried their contamination over into the canned product, making sterilization difficult.

Detecting Coal Tar Dyes in Butter

THE method calls first for the separation of the fat from the melted sample by filtration at a temperature not above 100° Cent. About 1 cubic centimeter of the fat in a test tube is heated in an oil bath to 185° Cent., during which time the tube is occasionally removed, shaken, and replaced. Vegetable butter colors, or the natural coloring matter of the butter fades to colorlessness within ten minutes at a temperature of 180 to 190° Cent. This is true only in case the fat has been separated at a temperature not above 100° Cent. If this precaution is not observed it will not become colorless on heating to higher temperatures. Coal tar dyes remain colored at the higher temperatures.

Inks

CIRCULAR No. 95 of the Bureau of Standards deals with the subject of inks, including methods of manufacture and testing. The information is general and interesting with emphasis placed upon methods of testing used at the Bureau and described in such detail as to make them available to any chemist. Writing and copying inks, duplicating and sympathetic inks, marking, canceling and stamping inks as well as the tablets and powders are discussed. The greatest variety of tests is applied to writing inks where resistance to light and reagents, keeping quality, fluidity, and penetration are determined as well as total solids, ash, iron, sulfuric anhydride, tannin, dye, and [illegible]mium content. The circular includes a bibliography.



New French projecting lantern which is effective in broad daylight, shown assembled and taken down

Counting Bacteria

By J. Beyer

AT the anti-typhus laboratories of the French Army serums are prepared in accordance with the rigorously scientific though somewhat complicated method of Professor Vincent. These precious immunity giving liquids do not contain any antiseptic but only billions of typhus bacilli The emulsion obtained is however too rich in microbes to be used as it stands for vaccination purposes. These cultures are therefore diluted with sterilized water and then very pure ether is added to the emulsion of typhus bacilli. The mixture is stirred for a few seconds and then left alone for five hours after which the lower part which contains all the bacilli and the soluble immunity-giving matter is drawn off On account of its lightness of weight, the ether floats above the liquid which with the addition of salt water makes up the serum.

But in order to bring the emulsion to the desired density, two billion microbes per cubic centimeter, their number must be estimated, which is done by using the Angus cell well known in laboratories and which enables the operator to count, by means of the microscope, the number of bacteria contained in a very small unit of volume. A certain quantity of pulp is taken together with a determined amount of water, then a drop of the solution is put in the cell which has been previously measured Knowing this last number as well as the number of microbes contained in said cell, the number of microbes contained in the first emulsion is deduced.

This matter of counting bacteria is a slow one and for some time the French anti-typhus laboratory has been using the opacimeter which was invented by Messrs Lambert, Vlès and Watteville. This instrument, which completes the work more quickly and precisely, is composed of a photometer formed by luminous circuits in juxtaposition furnished by the same source, one going through the bottle containing the emulsion and the other submitted to a dimming process capable of modifying its intensity in accordance with a determined

(*Continued on page 35*)

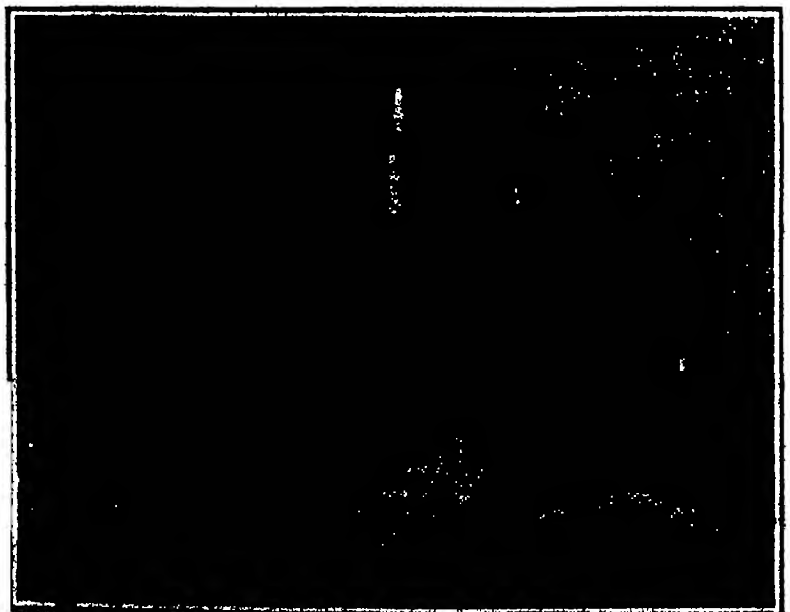
The centrifuge in which the bacterial solutions are given their final preparation for use

Daylight Projection of Opaque Subjects

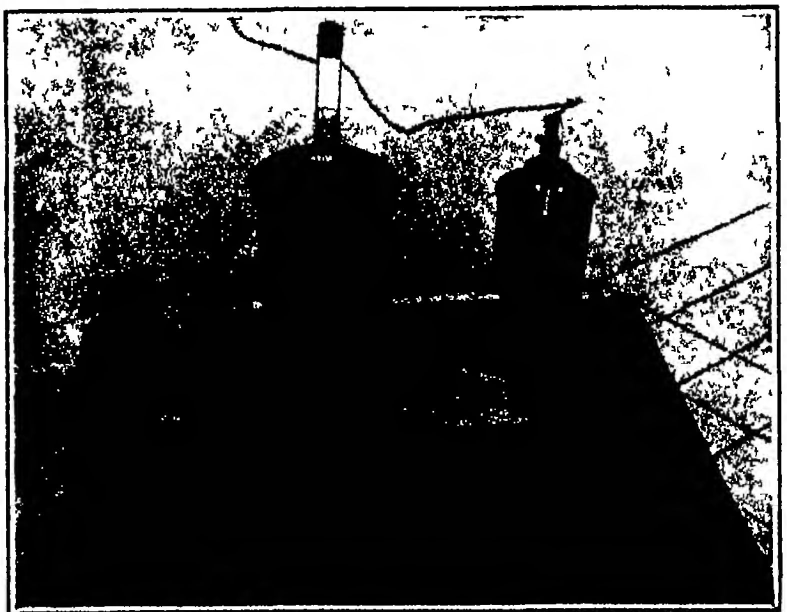
By George Gaulois

WE illustrate herewith a recently marketed French apparatus which makes it possible, in a light room, to project either upon a screen or upon any vertical horizontal or oblique surfaces, with the same degree of freedom ordinarily enjoyed in a darkened chamber The apparatus is suited for use with lamps and current of any description whatever The installation shown in our pictures will project upon nine square meters of surface (a square approximately 3 yards on a side) The projection is effected by means of light reflected from the object, rather than by transmitted light, hence no specially prepared negative or transparency has to be made, the projection being direct from the original to the screen It is anticipated that the new apparatus will have a wide range of utility in connection with the examination in detail of maps, illustrations etc The French announcements feature the possibilities of using it in connection with photographic maps made in airplanes, to detect forgeries in documents of any character, to throw upon the screen before an audience original documents of any sort whatever etc The secret of the success of the new apparatus is stated to lie in the arrangement of the reflectors behind the source of light, and in the short focus of the lenses employed to concentrate further this light upon the object

The new French projector is simple enough, as will be noted by studying the accompanying illustrations. It consists of a lamp house provided with a powerful condenser the balance of the optical system contained in another unit, and the member that holds the subject to be projected in position By having the objective lens mounted vertically instead of horizontally, the construction is greatly simplified



[illegible] opacimeter to get the photometric reading



Opacimeter with cover removed to show the interior arrangements

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Air-chambers 3½ by 8 inches are provided in this brick wall to absorb moisture penetrating outer wall

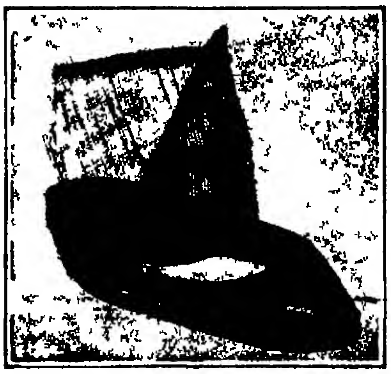
Something New in Brick Walls, Using Standard Bricks

SOME twoscore building commissioners from leading cities of the country saw an interesting test of the new hollow brick wall, which is being promoted by the Common Brick Manufacturers Association of America at their recent conference in Cleveland. Practically all of them will recommend it for adoption under the building codes of their cities.

The wall can be built in any thickness and claim is made for it that by reason of breaking the continuous mortar joints that exist in solid brick walls it becomes impervious to the penetration of moisture. Plastering is done directly upon the inside veneer with complete freedom from detrimental moist effects whether the wall be 8, 12 or 16 inches.

In this wall the bricks are laid on edge with headers at every joint in an 8-inch wall, but at varying distances in the thicker walls. Builders say it offers a saving of one-third in brick one-half in mortar and twenty five per cent in labor cost, in addition to saving the cost of furring for plastering when the wall is done. It has been used successfully in half a dozen states.

The Cleveland test was made with two walls of 8-inch thickness, 9 feet high and 12 feet long, paralleling each other at a distance of 12 feet apart. A short return was built at each end. Four types of construction were provided.



Simple device which is placed between carbureter and manifold in order more fully to vaporize the fuel

Upon a heavy platform upon these walls was built a 12 inch all rolok wall 4 feet high forming a complete inclosure. Into this was dumped sand which together with the platform and walls represented an aggregate weight of in excess of 83 tons, the equivalent of the weight of an average two-story, seven-room house, or approximately three times the burden that would ordinarily be imposed upon them. Not the slightest evidence of stress appeared even under this most severe test.

The wall has never been adequately tested but such tests will be made shortly with the ten million ton machine of the Bureau of Standards at Pittsburgh. The Bureau at present is conducting fire tests.

More Miles to the Gallon of Gasoline

THE little economiser shown in the accompanying illustration fits between the carburetor and the manifold, and enters into the intake manifold. It is made up of a fine mesh of copper wire stretched tightly over a flat spiral, the edges of the wire extending out between two flat plates of asbestos material which is fireproof.

The gas must pass over the spiral of the economizer and through the fine mesh copper wire, which acts as a sieve. This is said to create a high explosive vapor which reaches the cylinder blocks and explodes with greatly added power. By passing through the spiral and the sieve-like copper wire every drop of fuel is converted into power—an explosive gas and not part liquid such as enters the motor often when no device of this general character is used. It is claimed that 25 per cent gas consumption can be saved.

A Handy Headlight Control for the Considerate Driver

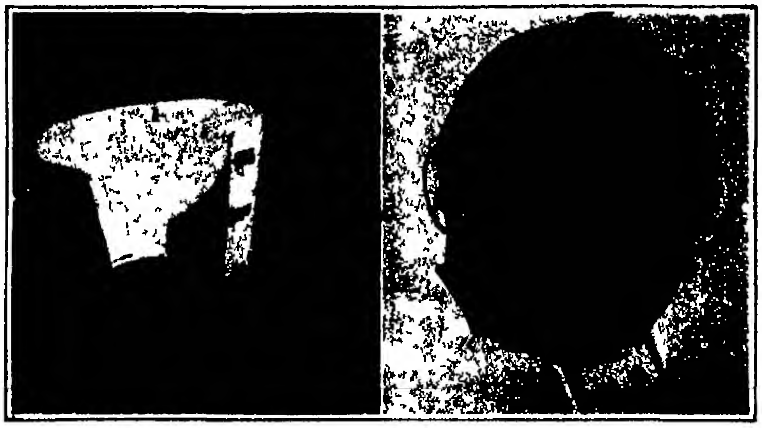
IN order to facilitate the changing of headlights from bright to dim and thus promote road courtesy without incurring the slightest inconvenience or danger, L. W. Auge of New York City has invented the little device shown in the accompanying illustration.

By using the simple device shown, the headlight control may be placed right on the steering wheel, always within ready reach of the driver who does not have to remove his hands from the steering wheel. When parking the car in a place where only a tail light is needed, this may be accomplished by raising one of the buttons on the switch box, thus leaving all headlights dark and only the tail light on. The switch does not interfere in any way whatever with the dash switch. Either switch can be operated independently. The device is so simple that it may be readily attached to any standard automobile in a short time without changes of any kind.

Making Evergreen Transplantation Practical

TRANSPLANTING anything from a head of lettuce to a large evergreen is always a fussy job and one that is *not always successful. In fact,* with the large plants and trees transplanting becomes difficult and problematical, especially in the case of evergreens which often die after being transplanted. This is attributed to the fact that the sacking enclosing the roots and earth ball forms more or less a flexible container, and the jars incidental to transportation quickly cause the earth around the vital roots to become loosened therefrom with serious or even fatal results.

With these facts in mind Lionel Weil of Goldsboro, N. C., has invented a transplanting receptacle which may be employed in transplanting all types of plants but more particularly trees of a less heavy nature. The receptacle consists of a metal casing, properly hinged, which is placed around the roots and earth ball of the tree to be transplanted. Metal slides at the bottom of the receptacle prevent the dirt from falling out of the tapered receptacle. Straps and buckles hold the earth ball firmly in place. In transplanting the tree a hole is first dug, after which the tree or plant with the receptacle still about it is placed in position. The bottom slides are removed, the buckles undone, and the receptacle removed, following which earth is packed around the earth ball containing the unimpaired roots. Even long-leaf pines, which are among the most difficult trees to transplant, have been handled with this device.



Metal receptacle for transplanting difficult plants and trees after removal from long-leaf pine tree, and the device alone

A Dustless Mop for the Dusty Job

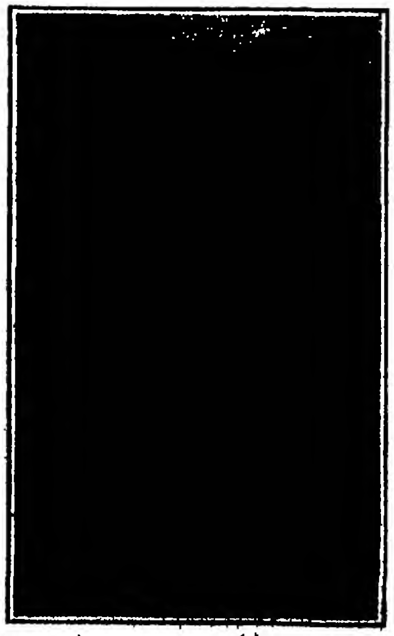
IT has remained for C. Juska of Rochester, Minn., to invent an ingenious cleaning device and bucket, which is shown in the accompanying illustration. The mop and the bucket are light in weight and are adaptable to many different cleaning operations about the home, shop, hospital, factory and so on.

The bucket is filled with water to a depth of about one inch above a screen. To free the mop of its dust and dirt, it is placed on the screen and moved gently back and forth several times so that the dirt is loosened from the cleaner head and passes through the screen to the water below. If the mop has been used wet for washing operations, it may be cleaned in the water and then wrung out by placing it on the roller as shown in the illustration, and rolling it back and forth to squeeze out the water.

The house cleaner can be used with a rag instead of a mop if desired, since the holder is arranged to take any form of cleaning member. The angle of the cleaning surface is adjustable with relation to the handle, so as to work in any position.

On account of the screen in the bucket, which acts as a perforated washboard through which the dirt settles and stays in the water below it, the cleaner is readily kept clean while in use as a mop or when cleaning walls. Again, after it has been used dry for cleaning walls or oiled for polishing floors, it can be easily and thoroughly washed in hot, soapy water and wrung out without being touched by the hands of the fair and gentle operator.

Tiny switchboard which may be mounted on automobile steering wheel for controlling lights



Wringing out the combination mop and duster by pressing it over the roller

The snap gage that indicates the degree to which the piece is short or over the standard

A Reading Limit-Gage

THE use of two snap gages, or a double gage with one opening set to "go" and the other for "not go" will be made unnecessary by the reading limit gage illustrated herewith This is set, just as is the "not go" member of the customary pair for the smallest diameter tolerable in the piece under test. But instead of being rigid or set so that the operator can merely tell whether the piece went clean or not, the movable jaw has sufficient play so that any piece which the machine can be conceived of as turning out will allow itself to be forced into the opening of the gage When this has been done, however, the pointer on the scale indicates the extent to which the minimum tolerable size has been exceeded. In many instances this is a preferable procedure for ordinary testing to the simple go and not-go type of gage, while in other cases, where it is necessary to classify the acceptable parts so that elements of the completed machine which are all "fat" or all "thin" or alternately the one and the other may be paired off; it is of extreme value Cylinders, for instance, may be classified as over sized, normal and under sized, all three falling within the extreme limits of toleration, and if pistons are similarly classified, a large piston may be assembled in a large cylinder and a somewhat better engine produced than if assembly were entirely indiscriminate Indeed, this procedure often admits of the enlargement of the toleration limits without impairing the product in any way

The Power-Driven Eraser

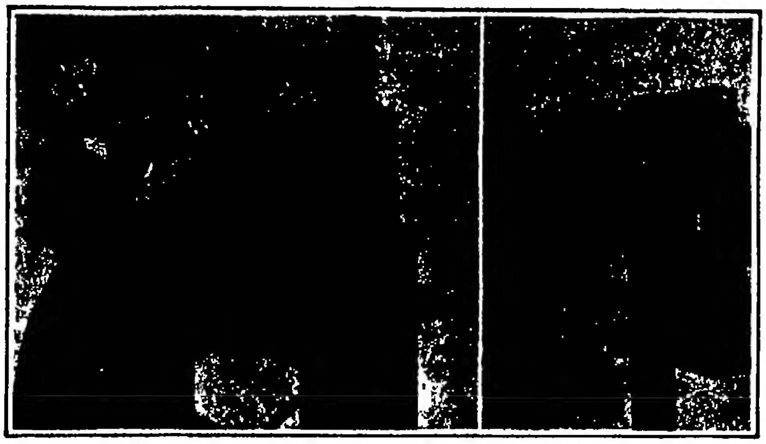
EVERYBODY has had experience with the difficulty of effecting a clean erasure of ink marks that shall leave no trace of the operation in the form of a broken surface that smudges the moment a fresh line is attempted across it. An ingenious architect has concluded that the trouble lies with the means ordinarily employed to produce the power behind the instrument, rather than with the eraser itself, and he has adapted the electric motor to drive the familiar circular eraser, much on the order of the dentist's drill The apparatus as we illustrate it is a home-made one, the base being an old dictaphone motor It can be attached to any electric socket, and does its work cleanly and quickly, leaving a surface barely marred at all, and easily capable of taking further ink lines without spreading

"Watch Your Hat and Coat"

THE signs exhorting the patron of restaurant and barber shop to check his garments with the cashier or keep his eye on them will be a thing of the past if a recent English invention becomes of general use. The weight of the overcoat on the hook releases a little trip, which allows the long, straight member (seen projecting at the top of the unoccupied hook in our photograph, and resembling a railroad spike in shape) to drop into contact with the broad, flat part of the hook. The overcoat is then locked on the hook and can be released only by a key corresponding in number with the hook It will be noted that this device will operate equally well with a coat that is properly hung by its hanger and with one that is hung over the end of the hook in the absence of the hanger or in the frequent event that this is broken In this case the coat itself is pinched between the spike and the hook A second retaining member swings over from the back of the frame and clamps the hat in place in similar fashion

The Photographer's Handy-Andy

THE commercial photographer who has on his shelves a wide choice of lenses, and whose work calls for intelligent selection among these, uses up a lot of time in putting them on and off his camera in the accustomed fashion Two simple attachments illustrated on this page will materially lessen the time thus spent. One of them is an ingenious device for lengthening the draw on a camera where a long focus lens is employed This consists merely in an extension to the front board of the camera, which makes possible the use of a lens of much longer focus than the machine was designed for The other is called by the photographer responsible for it the "master front-board" It consists of three strips nailed to the regular front board of the instrument, with a large opening at the fourth side of the quadrilateral, and with the strips cut away on the inner sides to form a flange in which the front boards of the lenses can be slipped This makes it possible to change lenses in a jiffy without the slightest fuss or trouble The ordinary practice is to mount the vision lenses on different lens boards, which must be shifted with the lenses



Left: Master front-board facilitating exchange of lenses. *Right:* Extension front-board that enlarges the scope of a single box.

Two handy contrivances for the photographic laboratory

Obstinate Fruit Stains on the Skin

THE obstinate stains produced upon the skin of the fingers by many fruits and certain vegetables, particularly potatoes, have recently been made the subject of a special scientific investigation by microscopical and chemical means, which produced results both interesting and surprising In one experiment microscopic sections of human skin were prepared and placed in an aqueous extract of potatoes. When examined through the microscope the observer was astonished to perceive that the outermost layer of the skin, the cuticle, was not colored by the potato extract. It was a deeper lying layer, the germinal layer, which is composed of epithelial cells which is colored, the layer below this, the "true skin" which is technically known as the corium and is sometimes called the "leather layer" does not change color Hence the section of skin seen under the microscope shows a narrow, sharply defined, dark line lying between the non-colored epidermis and the noncolored corium

Evidently, therefore, this middle layer or epithelium possesses a special capacity for uniting with the dyestuff contained in the potato This is all the more interesting because it is this layer of cells which contains the pigment which produces the darkness of the skin in brunettes and the so-called colored races Curiously enough, the skin was stained intensively even when the potato extract was not itself very dark but merely pinkish in color

Puzzled by this phenomenon the experimenter continued his researches and found that the potato extract undergoes, upon exposure to air, a series of changes in color, passing through the various shades of reddish yellow, mahogany brown and violet blue and finally becoming quite black Besides passing through these various changes of color the extract which when first made was comparatively clear, becomes increasingly cloudy and less and less transparent until finally, the black coloring matter within it is so dense and heavy that it forms a precipitate at the bottom of the vessel

This change of color can be considerably accelerated by the addition to the extract of certain metal compounds of a basic character—metallic oxides, for example According to Dr Robert Willheim of Vienna, to whose article in *Die Umshau* (Frankfurt) we are indebted for an account of these experiments, this last experiment plainly indicates that there is catalytic action involved Thus, the cells of the epithelium behave precisely like the powdered oxide That the catalytic action is not due to any sort of enzyme or ferment located in the epithelium is proved by the fact that the decoloration takes place even when the section skin has been previously boiled. We are justified in concluding therefore that the epithelial layer of the human skin possesses certain elements which are capable, like metal oxides, of attaching to their upper surface certain substances, especially of a colloidal nature, particularly when they possess an acid character, and which are, therefore, capable of strengthening the union made by absorption through chemical action also.

Hat-and-coat hook that locks on the garments entrusted to its care

The motor-driven eraser and its manner of use

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

OBSERVATION KITE BALLOON.—E. PRASSONE and L. AVORIO, Rome Italy The invention relates to observation kite balloons of the type in which stability is maintained by the action of the wind meeting the balloon combined with the pull of the mooring rope. The device consists of a gas container or bag of moderately elongated shape connected with a conical or pointed appendage with stabilizing or rudder bags the rudder bags being filled with air

Pertaining to Apparel

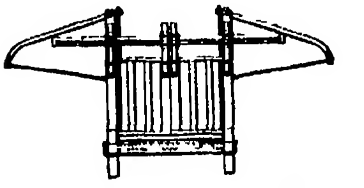
GARTER.—B A MANNY and J A RIBITT, 108 Worth St, New York, N Y The object of the invention is to provide a garter more especially designed for holding up socks in a very simple manner, and without the use of hooks, the garter being wholly devoid of metal parts, clamps or similar fastening devices. Another object is to permit of conveniently placing the garter on the wearer's leg and in engagement with the sock to be held up

Electrical Devices

CIRCUIT BREAKER.—G O O DAVIES Cle Elum Wash The invention relates to an automatic electro-magnetic, overload circuit breaker of compact form adjustable to plug fuse receptacles, to be employed in house lighting and other electrical circuits. The objects are to provide a more efficient device for the protection of electrical circuits from the damage wrought by over loading or short circuits to provide for readily determining which circuit breaker has broken the electrical circuit and to provide means for easily completing a circuit which has been broken

Of Interest to Farmers

GATE.—D M MCCAULEY Pastor Presbyterian Church, Taos, N Mex More particularly the invention relates to mechanism for gates, an object being to provide a gate normally positioned across an entrance or rail way crossing which automatically opens to



A FRONT ELEVATION OF THE GATE

allow an automobile or other vehicle to pass through and automatically closes after the vehicle has passed without necessitating the driver's alighting The gate is held by locking means which must be released by the weight of the vehicle and will resist manual operation

Of General Interest

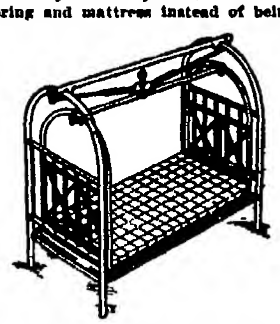
ANIMAL TRAP.—E E KOHL, c/o L J O Marr, Barr Bldg Sheridan, Wyo The invention relates more particularly to a trap adapted for catching gophers. The object is to provide a trap of this character which is of simple and durable construction reliable and effective in operation and easy and inexpensive to manufacture

ANIMAL TRAP.—W F LANGE Box 34, Runge Texas. The object of the invention is to provide a trap especially adapted for use in the extermination of mice and similar rodents A further object is to provide a trap of this character of extremely simple construction highly effective in use and easy and inexpensive to manufacture

RUG EXTRACTOR.—A P MAISS, 734 Hamilton St, Allentown Pa The invention relates to a device whereby a single rug may be drawn or extracted from between piles kept on sale in rug and carpet stores for the purpose of exhibition or sale An object is to provide a simple and effective device by which the rug may be extracted and at the same time rolled around a pole to keep the rug in shape and permit more convenient handling

ALLOYS.—F MILLIKEN, 110 William St., New York, N Y Among the objects of this invention is to provide an alloy characterized by a high resistance to the corrosion of acid and capable of withstanding high temperatures. A further object is to provide an alloy especially serviceable for use in the manufacture of still plugs and other fittings liable to be subjected to the action of acids. The alloy is composed as follows Copper 45-55%, nickel, 29-35% lead, 1-3%, zinc, 5-9%, iron 4-8%, silicon, approximately 30%

BED.—J P DIECKMANN, Route 2, Oakfield, Wis. An object is to provide a bed which will give readily with the weight of an occupant. A further object is to provide a bed in which the spring and mattress instead of being sup



A PERSPECTIVE VIEW OF THE BED

ported upon the side bars of a bed frame are supported on a frame suspended from a cross bar attached to the head and foot pieces of the stationary bed frame Springs support the frame which is adapted to sink downwardly with the weight of an occupant

CURTAIN HOLDER.—L B GARRABRANT, 61 A S Elliott Place Brooklyn N Y An object of this invention is to provide a curtain holder arranged to permit the user to readily and quickly fasten the holder in position on the window frame without the use of separate screws of similar fastening devices. A further object is to provide component parts, including means for fastening the holder attached to one another to prevent loss of any of the parts

MAGAZINE BINDER.—F H CRUMP, 225 E 4th St, Los Angeles, Cal. The invention has for its object to provide a binder within which a magazine may be readily secured and which will not only protect the magazine, but will support the same in condition to be more readily read Another aim is to provide a clamping element so constructed that it will bind a magazine whether sewed, wire-stitched or otherwise held together

CRAYON HOLDER.—P M BIONDO, 72 Throop Ave Brooklyn, N Y The object of this invention is to provide a crayon or chalk holder more especially designed for use in schools and other places, to securely hold a crayon or piece of chalk in place while writing or drawing on the blackboard The holder permits of readily adjusting the crayon and is simple and durable in construction and cheap to manufacture

INSECT CATCHER.—B R JOLLY, c/o Raleigh Savings Trust Co Raleigh, N C. This invention relates generally to insect catchers and more particularly to a mechanical suction trap an object being the provision of a manually controlled and manipulated device by means of which flies, mosquitoes and other small insects may be readily and easily caught, trapped and killed

CHECK PROTECTOR.—A C. WOODRUFF, Burns, Oregon The particular object of this invention is to provide an implement for printing and perforating checks for safety purposes, the device being adapted to be readily carried in the pocket it being relatively small and compact The implement is so arranged that the check may be stamped, perforated and automatically advanced during each operation

PORTABLE BURGLAR ALARM.—S. SUNDEL, address M Strachansky, Thompson and Foron Rd., East Haven, Conn Among the objects of the invention is to provide a portable burglar alarm for the use of travelers and other persons, and arranged for convenient attachment to a door, window or other movable part with a view to sounding an alarm on the movement of such part. Another object is to allow of setting the alarm to keep on sounding should the door be closed again after the alarm is started.

COMPOSITE AUTOMATIC FIREARM.—W. E BOSSHOSH c/o Inland Empire Paper Co., Millwood, Wis. The invention relates to recoil-operated, breech-loading hand firearms. The object is to provide a composite automatic hand firearm which can be readily changed for use in target practice or for service by the use of comparatively inexpensive interchangeable parts to accommodate the various cartridges of the hand firearm type which are of various caliber and power

CAMERA.—M OCHOA, address Rapael Restrepe, 21 Park Row, New York, N Y The invention has for an object to provide a camera wherein a large number of exposures may be made while using a comparatively small construction Another object is to provide a construction where the same lens is used for the finder and for the main focusing lens. A further object is to provide a camera which is so small that it may be used openly, or covertly in a hand bag.

PORTABLE DIFFUSION APPARATUS.—R. MOULIN 35 Rue Brulee, Paris, France. The invention relates to apparatus for the diffusing of essence or volatile liquids, and it comprises a hermetically closed receptacle, containing the liquid and having a wick immersed therein and extending out through the metal stopper so that the liquid is drawn out by capillary attraction. The apparatus is contained in a metal case the cover of which is pierced with small holes, thus permitting the vapors to escape, but protecting objects from all contact with the impregnable wick

COMBINATION FILTER PRESS AND DRIER.—J J NAUGLE, 300 Macon St., New York, N Y An object of this invention is to provide an automatically filtering filter press in which the residual cake may be discharged without the aid of a fluid Another object is to provide a filter press having a sectional housing, the stationary part of which presents a supporting wall for the filter plates and from which plates the cakes will detach under its own weight as soon as the movable sectional parts of the housing is displaced

Hardware and Tools

PLUMBER'S FERRET.—C W SHEATSLEY, c/o Pensacola Shipbuilding Co., Pensacola, Fla. The object of this invention is to provide a construction in the form of flexible pliers which can be bent around a bend, or variously positioned to grasp and remove obstructions. The device is extremely simple in construction, and is strong and durable in use

TOOL.—F H HILLARD, 401 S Main St., Fitzgerald, Ga This invention has for its object to provide a tool especially adapted for use with motor vehicles, wherein a blade is provided having a handle provided with an offset portion forming a stop for permitting the tool to be used as a jack pedal, the blade being adapted for moving dirt, or the like, and having openings to permit the tool to be used as a wrench and either the handle or blade serving to assist in removing or replacing a tire.

COMBINED KEYHOLE GUARD.—J SOMORA, 362 N Avers Ave., Chicago, Ill. An object of the invention is to provide a key hole guard adapted to be applied to a lock of ordinary construction and having means movable relative to the keyhole of the lock, and means controlling the operation of a shutter which prevents or permits the insertion of a key into the keyhole

Heating and Lighting

WATER HEATER.—F J CLIFFORD, Pateros, Wash Among the objects of the invention is to provide a device especially adapted for vaporizing water wherein the heating element is interposed in an electrical circuit normally open and adapted to be closed by the unvaporized water, the arrangement being such that when the water is all vaporized the circuit will be broken

Machines and Mechanical Devices

GEAR CUTTING ATTACHMENT FOR MILLING MACHINES.—M. FOOTE, 2000 Beverly St., Richmond, Va. The invention relates generally to gear cutting devices, but more particularly to attachments for milling machines for cutting bevel gears, the prime object being the provision of a device which will automatically cut and counter the teeth of bevel gears in such manner as is now impossible on machines of this character

SPEED INDICATOR.—J R. SMITH, 1811 Center St., Calgary, Canada. The object of the invention is to provide a device especially adapted for use with aerial or marine vessels, for measuring and indicating the velocity of the moving object with respect to the fixed object, wherein a device is provided to enable the observer to retain the sighting device on the fixed object, and indicating mechanism controlled by the swinging of the sighting device, and wherein the relative speed arm and the recording mechanism is capable of being varied in accordance with the altitude or with the range.

LAWN MOWER.—G. WOOD, 1548 W 61st St., Seattle, Wash This invention is of the monocycle type and includes a novel drive from the single running wheel to the rotary cutter in a way to cut close to a fence or hedge. Provision is made for the cutter accommodating itself to any unevenness of the ground without affecting the drive connection. The cutter is optionally raised or lowered by turning the cross bar of handle to wind or unwind a chain.

TEXTILE FINISHING DRUM.—J LUNEPP, South River, N J This invention refers more particularly to mechanism for the treatment of laces and embroideries. An object is to provide a finishing drum upon which lace or embroidery may be wound for the final treatment in various solutions followed by drying, and to prevent the lace which is wound upon it from shrinking.

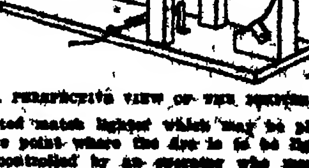
APPARATUS FOR THE DEVELOPING, ETC., OF FILMS.—R. C HUBBARD, c/o Ertograph Co., 208 W 146th St., New York, N. Y This invention has for its object to provide a machine whereby motion picture films are run back and forth, in developing, washing and fixing, the desired period of treatment in each operation being reliable. An important feature is that the film travels horizontal in its runs back and forth, whereby a shallow tank can be employed, and the film at any time can be fully observed

CLAMP DOG.—A. P MILLER, 148 W Vermont St., Indianapolis, Ind. A particular object of the invention is to provide a clamp dog especially adapted for use with grinders or lathes. A further object is to provide a dog or driver which is adjustable and otherwise so constructed and operated as to exert a powerful, effective gripping action on the work to transmit the required rotation to the work without marring the surface of the same.

SIGNALING DEVICE.—L. R. WALKER, Etna Mills, Cal. The object of this invention is to provide mechanism of the character specified adapted to be arranged on highways for warning drivers approaching each other from opposite directions, at dangerous places in the road, wherein each car as it approaches the danger point, operates the mechanism which controls the signal at the opposite side of the danger point, for a specified length of time.

ATTACHMENT FOR COAL CONVEYORS.—C G. WALKER, Bramwell, W Va. The invention relates generally to coal mining machinery, and particularly to an attachment for stationary or movable conveyors, the purpose being the provision of a simple and inexpensive device which can be readily attached to a conveyor for automatically controlling the passage of coal therefrom to prevent breakage of the coal and to uniformly distribute the coal to a second conveyor

FIRE IGNITER.—H PIERCE, Box 166, Paragould, Ark. An object of the invention is to provide mechanism for igniting fires at a distance. A further object is to provide a trigger



A PERSPECTIVE VIEW OF THE IGNITER

operated match lighter which may be placed at the point where the fire is to be lighted and controlled by an operator who may be some distance away. The device is practical and durable, and may be manufactured at a relatively low cost.

KEY BOARD FINGER GUIDE.—[illegible], 10 S. Broad St., Trenton, N. J. This

(Continued on page [illegible])

The Giant Junk Yard

(Continued from page 20)

into the ground just alongside the mountain of scrap, which is brought in from all over the country and unloaded by magnets—it is tin-plate with an iron base, of course. The shavings are forced into the chamber of the press and compressed into a block eight by twelve by twenty inches. In this form manufacturers buy the stuff for remelting Thousands of tons of it are used every year

The Philadelphia company has been best known to the general public for its marine work in salvaging vessels, because of the spectacular nature of this pursuit and the fact that famous old fighting ships fall into its hands. Its specialty, however, is the purchase of any kind of metal junk that the ordinary dealer is not equipped to handle The company will buy the lightest or the heaviest scrap in the world It has torn down hundreds of bridges Recently its workmen swept away every trace of the old Columbia Bridge over the Schuylkill River at Philadelphia in less than sixty days. This iron structure was put up at the time of the Centennial Exposition and has now been replaced with a modern bridge.

The firm also buys railroads and trolley lines—including everything from ties to power plant A single sixteen wheel trolley car now stands on a side track in the yard to bear witness that there was once a trolley line called the Cape May Delaware Bay and Sewell Point Railroad with eighteen miles of track, its own power station and right of way and twenty cars The junkman bought every thing but the right of way, repaired and sold some of the cars smashed and cut up the others for remelting dismantled the plant and scrapped most of the equipment The company also bought and dismantled the electric railroad from Danbury, Conn to Harlem N Y

Since the ending of the World War this concern has been perhaps the largest buyer in the country of metal ranging from the vicious four point barbed wire to shell Recently the last of the shell castings, totaling about twenty five thousand tons, was shipped to a firm at Glasgow Scotland, to be melted and used in the manufacture of machinery and tools All other war material except about four hundred miles of barbed wire and a large number of hydraulic presses built at a cost of $10 000 each to compress powder has been broken up and sold The barbed wire is being sold to farmers all over the country It was meant to guard the trenches of the Allies, but it was never sent abroad

There is, of course a large quantity of nickel-steel armor Most of the tonnage of this kind now in the yard came from the monitor Amphitrite, but there are also some remnants of the battleship Iowa" in the shape of armor and fighting masts All of this material is cut up with the oxy acetylene torch and sent back to the foundries for remelting Plates and bars of steel and iron that contain no nickel are first cut into handling sizes with the torch, and then chopped up in huge shears the jaws of which will bite through six square inches of steel

In general it may be said that there is no specific use for the different types of iron and steel scrap All of it goes to the foundry and the steel plants to be melted over again It is the practice in these mills to use the old metal in combination with a new ore—just as reworked wool is used with new wool in the making of clothing. It is then used in the manufacture of machinery—even in tools that are put to hard use. No one knows just what form the locomotive may take after the junk dealers have broken it into sizes suitable for the furnaces. Parts of it may go back into the same service and other parts only [illegible]

[illegible]

discovered specific markets It is the custom of wire mills for instance to draw wire to a certain bundle-length and frequently an ingot from which the wire is being drawn will not be large enough to complete the last bundle At other times the wire breaks This results in what are called 'shorts which are sold as scrap The junk yard contains about a thousand miles of this wire for which a ready market has been found only within the last few years Inquiry throughout the world brought to light the fact that three or four Chinese and Japanese firms are buyers of this material They dispose of it in small lots to native metal workers who use it in the construction of various n v elties Buyers of this material send out definite specifications for what they want They buy one hundred tons of used American horse shoes at a time for instance and these are melted up by the smiths and used in making razors, pen knives and novelties.

The scrap yard has a sky line all its own to one walking between the towering piles of metal junk One such pile consists of all sorts of curious shapes some of which weigh forty and fifty tons These are the skulls from steel plants which is the name given to metal that runs over the top of the mold or the metal which hardens in a furnace because of an accident The total amount of this steel in any one plant is too small for the manufacturing company to bother with Skulls accordingly are bought by this yard to be broken up for the furnaces

A five ton weight mounted on a derrick mast is used for most of the breaking up Under this treatment the stoutest boiler r other piece of machinery soon becomes unrecognizable and ready for the fire that will reconvert it into something useful In this connection no machine is scrapped that is susceptible of salvaging The company operates a machine shop where locomotives road rollers sewing machines and virtually everything else that can be induced to move is rebuilt where possible and sold for continued use A large percentage of the metalplate scrap obtained is used for the manufacture of washers in all sorts of shapes and sizes This company made all the washers used in the construction of the Panama Canal

Some of the workmen engaged in the dismantling of plants become as expert as lumber jacks in their own line It is a boast of the company that its men can drop a smoke stack within five feet of any given point Various methods are used for this work Foundations are cut away on one side and dynamite is used in some instances Where that is impracticable foundations are replaced with timber underpinning until the stack can be expected to topple of its own weight when these are removed The timbers are then burned away For tearing down gas holders the company uses a special axe which cuts through wrought iron as though it were light wood

A metal junk yard may be likened to a history of the early days of industry But it touches other things besides the romance of business The company some years ago, dismantled the power house of Sing Sing prison And even the big dynamos used to execute the first of the New York gunmen are now serving some useful purpose They were dismantled broken up and sold to be remelted Sooner or later some use is found for every pound of metallic scrap that is kept off the dump heap

Weapons at Sea

(Continued from page 25)

torpedo hits are, generally in spots unprotected by armor Again in the case of torpedoes, the explosive effect is enhanced by the inertness of water, for, by water pressure, the full force of the explosion is transmitted to the attacked ship's hull.

(Continued on page 35)

RECENTLY PATENTED INVENTIONS

(*Continued from page 32*)

invention relates to instruments having manually operated keys such as typewriting and typesetting machines in which the keys are arranged in banks or associated rows. Among the objects is to provide means to enable the learner to quickly and easily master the key board for the manipulation of the machine under what is commonly called the touch system"

MACHINE FOR SHREDDING BAMBOO AND THE LIKE.—A H WILLIAMS Plant City Fla This invention relates to a machine for shredding bamboo for the purpose of making brooms. A further object is to provide a machine which in one operation makes straws out of which brooms are to be manufactured wherein the bamboo or similar material is shredded by reciprocating lengths thereof over suitably arranged means for accomplishing the purpose

SPOOL RACK.—R BLACK, 2182 Mohegan Ave., Bronx, N Y This invention particularly relates to spool racks for use in connection with warping mills or weaving machines. The principal object is to provide a spool rack which is so constructed as to permit of the combined use of a sufficient number of racks in connection with a warping mill or a weaving machine as to run the mill simultaneously the required number of threads for the maximum width of the cloth in one operation.

KNIFE FOR CUTTERS.—H B. WILLIAMS 271 Bainbridge St, Brooklyn N Y This invention pertains more particularly to machines employed for trimming paper The primary object is to so construct the knife carrier as to greatly facilitate the operation of placing the knife therein and removing the same therefrom. By this method the danger of accident in the operation of attaching and detaching heavy knives is greatly reduced.

Medical Devices

DENTAL ARTICULATOR.—J HOMER c/o Thomas A J Drady 704 Parker Ave Roxbury, Mass. An object of this invention is to provide an apparatus which materially reduces the time and labor required to manufacture sets of false teeth Another object is to provide an apparatus whereby a set of false teeth may be made which when inserted in the patient's mouth will result in the maintenance of natural facial expressions, both in repose and in the movements of the features.

Musical Devices

PHONOGRAPH.—C A. PETTIT, 8133 N Sarah St, St Louis, Mo. The aim of this invention is to provide a device more particularly known as a magazine phonograph An object is to provide a receiving compartment or magazine adapted to accommodate an almost unlimited number of records. A still further object is the construction of a machine in which any records may be instantly available for reproduction and in which it will not be necessary for the operator to handle any of the records.

MUSIC LYRE HOLDER.—W C RAIN 611 W Crawford St Elkhard Ind This invention relates to musical racks and more particularly to holders such as are used on band instruments An object is to produce a holder for use on such instruments as a clarinet and the like in which the lyre portion is held securely to the support without the use of set screws such as are commonly used but having a clamping ring to include the body of the instrument.

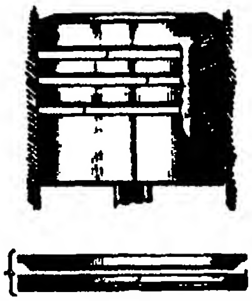
VIOL.—A F GROEBL, E. Main St Oyster Bay N Y The object of this invention is to provide a viol wherein a strong simple structure is produced capable of resisting rough use A further object is to provide what may be termed a combined violin and banjo the parts being so arranged that the violin shape and general characteristics are retained while the banjo head is provided and held in place regardless of weather conditions.

Prime Movers and Their Accessories

GAS ENGINE.—W E DRISCH, Bremen Ind This invention relates to gas engines of the multi cylinder two cycle type An important object is the provision of an engine in which is provided a novel port and passage arrangement for effecting the transfer of a charge from the compressing and charge forming section of one cylinder to the explosion section of the next adjacent cylinder, the invention being adaptable for use in connection with any tw-cycle motor having an even number of cylinders set side by side in parallel relation or arranged as in a V type motor or in opposed relation

COMBINED SPARK PLUG TERMINAL AND PROTECTOR.—R. H WEBER, Renier, Minn. The invention has for its object to provide a device wherein a one-piece combined terminal and protector is provided for conveniently attaching the wire to the plug without tools or solder, and without the possibility of receiving a shock from contact with the parts. A fgurther object is to provide a device for preventing the terminal from becoming detached from the spark plug accidentally

PISTON RING.—J O NEAL and J F HAEFFNER Box 107, Granite City Ill A purpose of the invention is the provision of a piston ring adapted for use on internal combustion engines comprised of two rings associated with



A PORTION OF A CYLINDER AND PISTON AND RINGS IN SECTION

each other in such manner that when in applied position one of the rings is actuated by the pressure of gas to expand the other ring into snug engagement with the walls of the cylinder and thus effectively prevent leakage.

Railways and Their Accessories

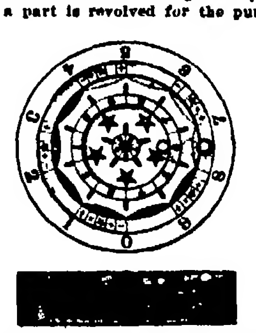
CONCRETE TIE.—A. C RAPELJE Box 288, Harrisburg Pa Among the objects of this invention is to provide a tie, wherein the body of the tie is composed of reinforced concrete, having at each end a rail seat across which the rail extends, said rail seat being of fibrous material and being anchored to the tie by the same means which connects the rail to the tie.

ENGINE INDICATOR.—L. E. HUNT, 985 Hamilton St, Springfield Mo. The object of this invention is to provide mechanism for use in engines of any character for indicating and recording the steam pressure at any port, the direction of movement and the relation between the operation of the valves and the said movement.

Pertaining to Recreation

PUZZLE.—J V WELLS 161 W 36th St., New York N Y An object of the invention is to provide a railroad puzzle which will be instructive and highly amusing to both old and young Another object is to provide a simple construction for the puzzle which may be easily and cheaply made The object is to reverse the position of two trains by manipulating the switches

COMBINED GAME AND EDUCATIONAL DEVICE.—F GOTHCHS, 416 Hoffman Ave, San Francisco Cal The principal object of the invention is to construct a game apparatus wherein a part is revolved for the purpose of



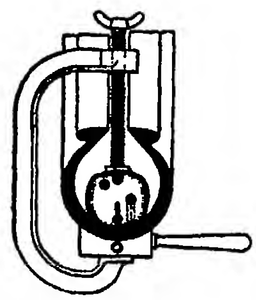
A TOP PLAN VIEW AND CROSS SECTION

propelling game pieces so that the same may fall into pockets denoting various numbers or characters. The game may be played by a number of persons, and being of simple construction may be placed on the market at a reasonable cost.

Pertaining to Vehicles

VEHICLE LIFT.—L F NADIG, Quakertown, Pa Among the objects of the invention is to provide a lifting device for vehicles which may be readily installed to raise the vehicle above the floor surface, to permit access to the lower and under portion of the vehicle without requiring a substantial portion of the floor to be cut away

VULCANIZING MOLD.—O M FRIDD, Hancock, Mich The invention particularly relates to repair devices for tires. The prime object being the provision of a device of this character, which is capable of use with tires of different dimensions. A further object is to pro-



A SECTIONAL VIEW OF THE DEVICE IN USE

vide a device in which the heating medium used is steam and in which the construction is such that the water of condensation may be properly carried off from within the heating chamber

FIFTH WHEEL.—M A. MORAN, JR., 608 Perrier St. New Orleans, La. Among the objects of the invention is to provide a fifth wheel supported on an elastically cushioned vibrating plate, and having a rocker shaft thereon providing pivotal mounting for a trailer section so that all thrusts, shocks and jars are absorbed regardless of the angle of the trailer section, or the condition of the road or angle of the turn.

COMBINED BUMPER AND LOCKING DEVICE.—W H CRISWELL, c/o Country Club Orchard, Merlin, Ore The object of the invention is to provide a combined bumper and locking device for use on automobiles and other power driven vehicles and arranged to permit the use of the bumper at the front end of the vehicle for the usual purposes or for holding the front or steering wheels in locked position to prevent steering of the vehicle.

AIR SPRING.—J J ISLER, Kipling, Mich An object of the invention is to provide mounting for a pneumatic cushion which will entirely enclose the cushion and which will permit the latter to freely function to absorb

A VIEW IN LONGITUDINAL SECTION

shocks and vibrations and give resilient support in any position in which it is used A further object is to provide a construction which is substantially watertight to prevent injury to the cushion through contact with atmospheric conditions.

MAGNETO CONTACT.—V RIGSBY, Hamphill, Texas. This invention particularly relates to a contact which may be used to advantage with the usual type of Ford magneto An object being to provide a contact which may be quickly and easily removed, cleaned, and replaced, and also one which will not make short circuits between the contact and the magneto.

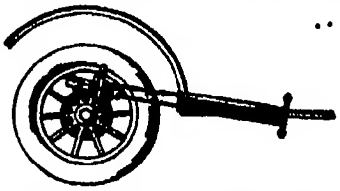
HYDRAULIC STEERING GEAR.—H. B. CRUM c/o Bucyrus Machine & Tool Co., Bucyrus, Ohio. The invention relates to steering gear for vehicles. An object is to produce a type of hydraulic steering gear for use on motor cars to supplant the present used worm and worm wheel type, or worm and segment type of steering gear to this end the inventor employs a simplified hydraulic pump and fluid motor or actuating means.

ANTISPLASH GUARD FOR MOTOR VEHICLES.—L. E. VASSEUR and M. TCHOUMATCH, 62 Rue de Louvre Viroflay, Seine et Oise, France. The object of this invention is to provide a guard intended to prevent the splashing of liquid mud outward, to accomplish this a brush is carried in a frame suspended from two vertical arms hinged on a plate which is adapted to move vertically and to swing on a plate secured to the chassis of the vehicle by arms which also support the brush frame by means of springs.

SWITCH LEVER OPERATING MECHANISM.—H. D BLUMENFELD, P O. Box 84, Haverstraw, N Y The primary object of this invention is to provide means for operating the ignition switch when the same is placed on the exterior of a box which in turn is carried by the dashboard of the vehicle A further object is to so construct a device that such switch may be operated from a point adjacent the steering wheel of the vehicle.

ADJUSTABLE TRACTIVE ATTACHMENT FOR TRACTION WHEELS.—R. D. BALLARD, 100 Central Ave., St. Petersburg, Fla. More particularly this invention relates to traction wheels of heavy vehicles, the object is to provide an inexpensive attachment of an adjustable nature, whereby to provide for the necessary grip upon roadway surfaces under varying conditions. Generally speaking the invention provides the use of radial adjustable tractive members whose outer ends are projectable through the rim of the wheel.

POWER ATTACHMENT FOR AUTOMOBILE HAND PUMPS.—C. C MOHNEY, c/o Book Supply Agency, Clintonville, Pa. This invention relates to tire pumps of the ordinary character for automobiles, and has for its object to provide mechanism for connecting the pump to a motor vehicle in such manner that



A VIEW SHOWING THE PUMP IN PLACE

when a rear wheel is jacked up and driven by the engine the pump will be operated, the pump being connected with the spokes of the wheel and the running board, making an engine-driven pump quickly and easily attached for inflating any tire on the car, either on the road or in the garage

CANOE TRAILER FOR MOTOR VEHICLES.—D B. WOODRUFF, Nesta Vista Ranch, Olathe, Colo. The invention has for its object to provide means whereby a canoe may be loaded with camp equippage, covered with a water tight and dust-proof cover, wheels placed under the canoe converting it into a wheeled vehicle of the trailer type, and connected to the rear of a motor vehicle to be drawn thereby

AUTOMOBILE LOCK.—W F JENKINS, 1814 Hanover Ave., Richmond, Va. Among the objects of the invention is to provide a simple and durable lock to be operatively associated with the steering wheel and post of an automobile. A further object is to provide a lock of such construction and material that it cannot be broken without great difficulty, thereby discouraging unauthorized removals of the automobile.

AUTOMOBILE LOCK.—J H PRICE, Cape Girardeau, Mo. This invention relates more particularly to locks for Ford automobiles. More especially the invention aims to provide movable locking arms with extensions engageable with one of the radial ribs or spokes of the steering wheel so that when these arms are locked the steering wheel will be securely held against rotative movement in addition to the locking of the spark and throttle levers.

Designs

DESIGN FOR A MOTOR VEHICLE RADIATOR.—V W PAGE, 809 Lafayette St., New York, N Y

DESIGN FOR A MUD GUARD.—E. L. TOMLINSON, North Branch, Mich.

Weapons at Sea

(Continued from page 33)

In considering the case of the capital ship, it must not be taken as a unit, but as a craft of great offensive power for gaining control of the sea, but which has a number of agencies, protective and offensive, to assist and protect it. If the protective agencies are allowed to lag behind the development of a new arm there is no occasion for hysteria concerning the passing of the capital ship, instead, there must be concentration on the provision of defense measures to meet the new menace. As in the past, you did not send out a battleship devoid of armor, and as in the present you give her a destroyer screen against submarines, so, in the future, she will have a protective service of fighting aircraft.

Notwithstanding all the hysteria concerning the passing of the capital ship as a type, it must be remembered that the cheapest and most powerful unit weapon is the *gun*. It hurls explosives in large quantities at enormous velocity The battleship is the type developed to use it at sea "And, the battleship or some other type adopted to carry this weapon, with protection inherent in itself, or in support ing types, against the menace from the air and subsurface, will always control the sea and be the dominating factor in naval warfare as long as commerce moves in surface ships. Should commerce in bulk and enormous quantities ever move by air, then, and only then, shall we see the battleship displaced as the dominating figure at sea.

However, the havoc made by the submarine against sea-borne commerce in the last war will be duplicated from the air in the next war, if defensive measures are not devised and provided to meet it As in this war with hostile submarines, so in the next, with hostile aircraft, any country will be at a great disadvantage if adequate air defense for its sea-borne commerce is not at hand

Aircraft, used as a destructive agency in a sea battle, can be largely discounted as a determining factor, for nullifying provisions will be made, aerially, by both sides before such a battle is initiated. But the use of aircraft on a large scale against merchant vessels will have the same application as the submarine unless measures are at hand for defense, namely, anti aircraft guns and counter air-defense The inability of the aircraft to operate for long periods without the assistance of a floating or land base will mitigate against its use and value. However, the merchant convoy of the next war will need two or more anti-aircraft guns on each ship, and one or more fighting planes on deck, especially when within 800 miles of the enemies' bases. If control of the sea is not already obtained, or if the enemy has carriers or men-of-war at sea, to be used as raiders, merchant ships must carry aircraft at all times.

The fanaticism of the air force advocates is not warranted so far as it calls for the destruction and abolition of surface types, particularly men-of-war or merchant vessels. Economy largely determines trade routes and methods of carriage. Both are susceptible of modification in time of war Sea-borne commerce for long hauls, will always, in peace time, be carried in surface craft, since such craft are and must be for this and the next generation the cheapest method of transport over water No nation can meet, in war time, an economic shortage of fuel or military supplies by air transport or sub-surface craft. An adequate number of such craft would not be built in peace time because of expense.

In war time a cause, already lost, might attempt as a last expedient to stem the flood of disaster with such straws as aircraft freighters alone, but they cannot be a determining factor in resisting economic shortage, when control of the sea is lost.

A Chat with Madame Curie

(Continued from page 25)

made an industry of it. Our radium production surpasses by far that of any other country We have found almost countless ways of putting radium to work, such as illuminating watch dials, locator buttons, house numbers, chain socket pendants, gun sights, instrument dials, and so on And what satisfaction for Madame Curie to learn, as she very quickly learned, that our methods of extracting radium from the carnotite ores of Colorado are precisely those which Professor Curie, her husband long since deceased, and herself employed in a modest laboratory back some two decades ago when radium was first isolated and studied by itself'

Despite twenty years of study and research devoted to radium and radioactivity, Madame Curie admits that she has much to learn And if she knows very little about this most interesting of scientific studies, who does? Radium, she tells us, must be handled with great care Careless or inexperienced handling may prove dangerous and perhaps fatal We noted that one of her hands had been affected by the radioactive rays and her general health, so she told us, had been undermined as the result of intensified wartime work with radium

But what will Madame Curie do with her gram of radium, now that she has realized the wish of her life time? That is a difficult question to answer Even a brief discussion on radium and radioactive properties soon leads to an impenetrable jungle of technology, through which the inexperienced layman cannot hope to pass. So Madame Curie, with a modest smile, could not tell us just what she intended to do with the precious gram She explained however that the Curie Institute in Paris divides its efforts along two main lines, namely, physicochemical and physicobiological as she terms them The former has to do with the study of radium and radioactive substances purely from the standpoint of the physicist, while the latter deals with their application to the treatment of human ailments Madame Curie impressed us as being as much interested in one as the other Answers to a few medical questions made us feel that her Doctor of Medicine degrees have been most appropriately awarded

However little Madame Curie may be able to explain to us as regards her future work with said gram of radium, one thing is certain, and that is that she needs rest and plenty of it. She told us the first part of her program called for protracted rest, extending through July and well into August By September she will be back in the Curie Institute, hard at work on the gram of radium Furthermore, she intends to carry on an extensive investigation with a large quantity of mesathorium, another radioactive substance, which she has taken back with her

It was a mighty tired but highly grateful and appreciative woman that sailed for France on June 25th. Down in that holy of holies—the specie room—of the "Olympic" was her precious gram of radium and a quantity of mesathorium, valued at $165,000 in all. Special precautions had to be taken on account of the ship's instruments, for the compasses must not be disturbed in their normal functions. The Bureau of Standards carried out the shipping instructions. A beautiful mahogany case lined with lead and steel was provided Although the box was not large, it weighed, with these linings, 130 pounds. Directly in the center of the box were several small compartments, formed of lead and surrounded by steel, each one of the right size to admit a small glass tube containing a portion of the radium salts—the form in which the metal is handled for shipment. The lid of the mahogany box was inlaid with a gold plate, handsomely marked with the following inscription· "Presented by the President of the United States on behalf of the women of America to Madame Marie Sklodowska Curie in recognition of her transcendent service to science and humanity in the discovery of radium. The White House, May 20, 1921"

Counting Bacteria

(Continued from page 29)

law The two circuits form in the ocular field two adjacent layers which the observer equalizes by the dimming process based either on polarization phenomena produced by glass prisms, or else by the gradual displacement of a dimming plate

In the new opacimeter the luminous source is a nitrogen lamp of 100 candle-power contained in a metallic globe, allowing light rays to pass in two rectangular directions. A lens projects a parallel pencil through two windows diametrically opposed in the side of a copper recipient full of water destined to receive the emulsion tube On going out, the pencil after having passed through a selective colored screen penetrates a total-reflection prism and then forms into a lens which throws the ray upon a glass cube formed by two right triangular prisms put together along their hypothenuses, one of which, partially silvered, throws it finally into the microscope The other pencil of light follows through the colored screen and passing through an objective it traverses the glass cube through its non silvered part and subsequently penetrates into the field of the ocular of the microscope Before penetrating into the objective this luminous ray passes through a photographic plate, more or less dimmed the intensity of darkening having been previously determined by means of spectrophotometric measures. This plate mounted on a glass cylinder pivots upon its center by the action of a little handle which the observer actuates from the outside and has a photographic scale dividing its length into 100 equal parts. In addition, the characteristics of the objective have been calculated so that the image of the divisions shall be formed on the level of the silver surface of the glass cube so that it may be seen in the microscope at the same time as the limit of the two layers. The equaling of the latter and the reading of the scale is therefore made in the same field In order that the observer be not influenced by any preconceived idea a handle allows him to actuate a movable shutter which reveals the graded scale at the exact moment needed

As the gradual dimness of this photographic plate or screen is measured by means of an arbitrary graduation, it is necessary to make an empirical calibration For that purpose a curve is constructed connecting the divisions to the standard chosen as representative of bacterian substance, such as for example the *dry weight* of bacteria per cubic centimeter of emulsion

After having taken as a standard a bacterian emulsion the same is divided in two parts One is put inside a centrifuge apparatus and the mixture at the bottom is drawn off and washed in distilled water, when it is weighed at 110 degrees. Thus, the net weight in milligrams per cubic centimeter of standard emulsion is obtained. With the other part a series of emulsions is made up which are successively examined through the opacimeter By using the amounts read out as abscissas and the corresponding dry weights as ordinates, the calibration curve is obtained In the laboratory the strength of the serums is not expressed in dry weight but by *the number of bacteria* per cubic centimeter and, therefore, after having obtained the standard, microscopic counts are made by means of the Angus cell Lastly, from time to time, the various adjustments of the apparatus are verified by means of opal-colored glass plates disposed in tubes and which are used for constant opacity tests.

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THE STUDY OF CHEMICAL COMPOSITION By Ida Freund New York The Macmillan Company, 1904 8vo , 650 pp., illustrated

This separate treatment of chemical composition concentrates attention upon important facts, and gives the initial discoveries and the trend of empirical knowledge It shows that the accepted notation is independent of the ultimate constitution of matter draws a distinct line between facts and hypotheses while emphasizing the usefulness of the latter, and elaborates selective researches that lend themselves to the illustration of various viewpoints in preference to attempting full historical detail.

THE IDYL OF THE SPLIT BAMBOO By George Parker Holden, M D , F.A C S Cincinnati Stewart and Kidd Company, 1920 8vo , 278 pp , illustrated

Here is another of those delightful Stewart Kidd books anent the art of angling The joys of the fisherman are sympathetically drawn there are chapters on rod making—splitting out and assembling tapers and plotting, gluing up and fitting windings and guides, handgrasps and reelseats are dealt with expertly and the reader is initiated into the home cultivation of silkworm gut, the technique of landing nets and equipment, and the features of a model angler s camp

PRACTICAL ENGLISH FOR NEW AMERICANS By Rose M O'Toole New York D C Heath and Company, 1920 8vo , 196 pp illustrated

The causes for Miss O Toole s brilliant success as a teacher of our foreign born are apparent in this simple reader with its carefully graded lessons Its ultimate purpose is Americanization the Facts at the end of each chapter to be memorized teach historical and political truths to that end The initial sections are full of splendid suggestions to teachers and deal with devices and methods and the conduct of factory classes

THE BOY SCOUTS YEAR BOOK 1920 Edited by Franklin K Mathews New York D Appleton and Company 8vo , 255 pp illustrated

There is a bookplate with space for the owner's name and any boy will be proud to have his name on such a book as this. He will thrill to high adventure in the air, yearn toward the woodsy cookery of Ladd Plumley, and ecstatically follow Dr Hornaday in the track of the great brown bears of Alaska Dan Beard tells how to make knife scabbards and hogans. If the reader is a wireless enthusiast or interested in popular science or in Indian lore, he will find here something about all of these things.

THE HUMAN MOTOR Or the Scientific Foundations of Labor and Industry By Jules Amar D Sc New York E P Dutton and Co , 1920 8vo 309 illustrations, numerous tables.

Of late years physiological data relating to working efficiency have been steadily accumulating and much of this accumulation is authentic and of practical help in industry Our author who is Director of the Research Laboratory of Industrial Labor at the *Conservatoire National des Arts et Metiers*, first summarizes general principles his lengthy consideration of the human body as a motor and of the conditions under which it attains its highest efficiency as a working instrument is a most interesting and enlightening piece of writing Properly understood and applied his shrewd and representative selections from the mass of literature available should lead directly to that desired consummation greater output with less expenditure of effort.

OLD AT FORTY OR YOUNG AT SIXTY By Robert S Carroll, M D New York The Macmillan Company, 1920 8vo , 147 pp., illustrated.

Dr Carroll, who will be remembered as the author of several popular works on jangled nerves and their retuning marshals such information as science and psychology offers to enable man to grow old gracefully, retaining his powers to an advanced age His workable recommendations embrace the physical, mental and spiritual and their adoption would without doubt bring greater comfort and satisfaction to the later years of life

ROAMING THROUGH THE WEST INDIES By Harry A Franck. New York The Century Co., 1920 8vo , 486 pp , illustrated

These sketches are the 'random pickings' of an eight months tour of the Antilles by the observant author of A Vagabond Journey Around the World " They are not intended as a traveler's guide, though there are many hints he might accept with benefit, their chief appeal is to those of us who do our traveling in a comfortable chair To such the story of this extended journey will prove absorbing The American West Indies receive closest attention but the British and French territory is also covered with page after page of fine illustrations from the author's photographs and a map of his itinerary

PHYSIOLOGY OF FARM ANIMALS By T B Wood C B.E , M.A , F.R S , and F H. A. Marshall, Sc D Part I General By F H A Marshall, Sc D New York G P Putnam's Sons, 1920, 8vo , 204 pp., 105 illustrations.

Students of agriculture and veterinary students will find this an unusually good treatise on a neglected branch of physiology The industrial importance of stock breeding and rearing is such that all resources of knowledge should be brought to bear upon them. The first volume of this work has chapters on histology the organs of digestion respiration and excretion the blood, the nervous system and so on until we come to a very thorough and well illustrated section on the generative organs and the mechanism of pregnancy and parturition The second volume will deal with animal nutrition

A THOUGHT BOOK ON THE SOCRATIC METHOD Edited by T Sharper Knowlson Philadelphia J B Lippincott Company 8vo , 200 pp

It would be hard to conceive of a work more stimulating to thought, more helpful to close, accurate reasoning on broad subjects than this unique offering of Mr Knowlson s. Each page is headed by a striking quotation provocative and intriguing the columns below provide space for questions, answers and notes, and in half the instances several questions are provided as models Two or more students using this text together will find many a fascinating evening in the book and will make rapid progress in the development of their mental powers.

BUILDING THE EMERGENCY FLEET By W C Mattox Cleveland The Penton Publishing Co , 1920 8vo , 279 pp 16 portraits, 21 illustrations 9 charts.

The former head of the Publication Section has here set down the full story of problems met with and overcome by the Emergency Fleet Corporation supplemented by an absorbing gallery of pictures portraying the directors of this vast undertaking ship exteriors and interiors launchings, and the Hog Island development Charts show how expenditures were converted into ships, how launchings and deliveries progressed and other comparative data of construction and costs. The volume has a dignified format is printed on a fine quality of paper and presents in readable form facts that all intelligent Americans should be interested in

ELEMENTARY COURSE IN PRINTING By Fred J Thoren Joliet, Ill , 905 Benton Street The Joliet Calendar Company 1920 8vo , 61 pp , illustrated

The author s course developed by his experience as printing instructor in the Chicago public schools, sets forth for the benefit of the teacher the most approved principles of organization, instructional procedure, and equipment. Most of the text is concerned with outlining an elementary course in which the points pertaining to typesetting composing and so forth are clearly brought out with a tabulation of exercises, lesson material, and layouts.

CREATIVE CHEMISTRY By Edwin E Slosson, M S , Ph D New York The Century Co , 1920 8vo , 311 pp , illustrated

In a most attractive form the literary editor of *The Independent* gives us the facts of recent achievements in the chemical industries. He divides human progress into three periods—the appropriative, the adaptive and the creative, taking the last as his theme. He justifies his title, talks entertainingly of such things as feeding the soil coal tar colors the rival sugars, solidified sunshine, and the products of the electric furnace, and, together with exact and edifying information, opens up magical vistas to the thoughtful reader

TAFT PAPERS ON LEAGUE OF NATIONS. Edited by Theodore Marburg, M.A., LL.D., and Horace E. Flack, Ph D New York The Macmillan Company, 1920 8vo ; 340 pp.

As everybody knows, Mr Taft stands for the League, and is quite as high an authority upon it as any of those arraigned against it. His Americanism cannot be questioned any more than can his legal knowledge and qualifications. These speeches and letters were made and written before the adoption of the revised Paris Covenant—with the exception of one article on the revised Covenant. Frankly asserting that, had he been a senator, he would have voted for this Covenant, "just as submitted,' he blames the President for refusing to accede to reasonable modifications of Article X Mr Taft's interpretations and opinions should be read by all who have the good of the country and of civilisation at heart, he makes the prediction that Mr Harding will be forced to ratify the League Covenant with reservations.

THE VENTILATION HAND BOOK By Charles L Hubbard, New York The Sheet Metal Publication Company, 1920. 8vo., 231 pp , 150 engravings

The first edition of this hand book, with its subject matter conveniently arranged in the form of questions and answers, was well received, and the present enlargement and revision has made of it an even better guide to good practice. It indicates the principles of ventilation as applied to furnace heating, treats of ducts, flues and dampers for gravity heating, explains fans and fan work, and concludes with a paper on the ventilation of ships.

MINERALOGY By Edward Henry Kraus, Ph D , Sc D , and Walter Fred Hunt, Ph D New York McGraw-Hill Book Company, 1920 8vo , 561 pp , illustrated

This new and attractive text serves as an introduction to the study of minerals and crystals, and is the fruit of long experience in teaching large classes of beginners. It compresses essentials into a single volume without sacrificing directness of treatment , instead of, or supplementing the conventional drawings of crystals, we have a series of fine original photographs. Mineralogy is sketched in its relationship to modern civilization and to the economic production and uses of minerals The human element is injected by means of photographs and thumb-nail biographies of distinguished mineralogists.

LESSONS IN HEAT By Wm S Franklin and Barry MacNutt. Bethlehem, Pa , Franklin and Charles, 1920 8vo , 147 pp , illustrated

The third volume in this Lesson Series" by two experienced educators and writers deals with heat. Their methods of teaching are directed toward coupling up mathematical ideas with actual conditions and actual things," hence their definitions while varying considerably from the classical form go to the heart of practice This, in college and technical school, lends vitality to a course, and holds the interest of students by its direct path to real and definite knowledge and results.

ADVANCED SHOP DRAWING By Vincent C George, B S New York McGraw Hill Book Company, 1920 8vo , 147 pp , illustrated

By the use of this text those who are already familiar with mechanical drawing may gain a practical knowledge of drafting as applied to various lines of engineering. Among the discussions of the book are pictorial representation, 'Patent Office drawings, electrical drawing, piping layouts, structural drawing and sheet metal work Some knowledge of orthographic projection and fair facility in the use of instruments should enable the student to master the progressive lessons with little difficulty

LEHRBUCH DER MATHEMATIK Herausgegeben von Esselborn Erster Band F Meisel, H Roth, E. H Schütz, 8vo , 643 pp , 785 figures. Zweiter Band G Ehrig, G Chr Mehrtens 8vo , 770 pp , 798 figures. Leipzig, Wilhelm Engelmann, 1920.

Vol. I of this comprehensive work deals with algebra, plane and solid geometry, and perspective Vol. II , with trigonometry, analytical geometry, differential and integral calculus and mechanics, concluding with the mechanics of construction Like all works emanating from this house, it is a very full and careful treatment of its subject by eminently qualified teachers and illustrates its points by a profuse use of diagrammatic material. To technical students with a good knowledge of German it will be illuminating and helpful in a high degree

HOW PAPER BOXES ARE MADE. By Robert F Salade. Lafayette, Ind : The Shears Publishing Company, 1920. 12mo.; 225 pp., illustrated.

This handy little book tells the beginner how to manufacture all sorts of paper boxes, there are special instructions on the printing department, on embossing and gold-leafing, on label work, etc., with many pictures of the machinery and of the finished product.

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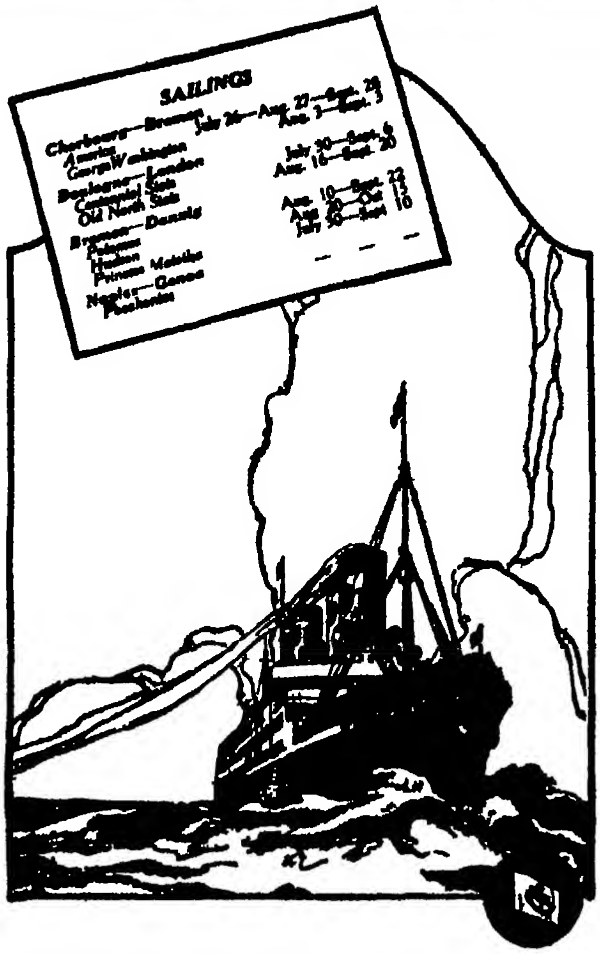

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1 Two-deck automobile ferry with oil-electric drive. 2 Two-deck automobile side-wheel ferry w th oil-electric drive 3 S ngle-deck automobile ferry w th oil-electr c d ve 4 Twin hull or catamaran ferry with Diesel-engine drive. 5 Main deck of catamaran boat showing gangways for automotive vehicles. 6 Plan view of catamaran hulls with their inte connect ng girders and longitudinals

Features of some of the remarkable ferry boats that are proposed for the handling of our heavy vehicular traffic

Something New in Ferries

By Robert G Skerrett

A NUMBER of our big and most industrious cities are so located that rivers bays etc necessitate the operating of ferry lines for the convenience both of passenger and vehicular traffic and with few exceptions the boats are of types which have been built pr marily for the accommodation of passengers with some space reserved on a single deck for the transport of vehicles of divers kinds. In consequence, during rush hour periods, it is no uncommon sight to see scores of horse-drawn and power-driven conveyances lined up awaiting their turns to get aboard the inadequate ferries. The congestion is inevitably intensified by the speed of the motor truck and the automobile which brings them to the focal point, while the slow moving vessels, with their intermittent schedules, strangle or bottle-neck the traffic tide A staggering amount of time is thus wasted going to and fro and it is probably no exaggeration to say that many millions of dollars are thus squandered in unproductive hours in the course of a twelvemonth This is certainly the case in the Port of New York, where numerous ferry lines are indispensable.

For some years it has been evident to students of the subject that vehicular traffic needs could be met only by the construction of craft especially designed for the carrying principally of self-powered conveyances—the accommodation of passengers, per se, to be a secondary matter It is interesti g t n te that Westerners have been foremost in th s de artn ent f naval archi tecture and plans ha e rece tly been developed look ing to the creation of a flotilla of double-d ck ferries for the handling of autom biles and m t r trucks across the waters contiguous to San Francisco the idea being to carry the vehicles on both the main and the upper decks to San Francisco One route is between San Francisco and Oakland on opposite shores of San Fran cisco Bay and another run is athwart the Golden Gate linking San Francisco with Sausalito in Marin County to the north.

Ferries of this nature w uld of c urse re uire modi fications of the terminal facilities That is to say it would be necessary to build an inclined runway or ramp leading to and from the level of the upper deck of the boats, and, in addition there may have to be provided adjustable aprons or platforms for both the upper and lower decks in order to take care of tidal differences. There are no engi eering difficulties of moment involved in these associat features and the expense entailed would soon be c vered by the increased revenue made possible thro h the amplified capacity of the vessels

The Western marine e gineers and naval architects have shown considerable ingenuity in their designs, and they have sought to avail themselves of typically mod ern propelling plants for their boats. That is to say they are convinced that the ends of economy can be best served by dispensing with the steam engine and substituting in its stead rime movers of the heavy oil Diesel attern Messrs D W Di kie and R Z Dickie have drawn u plans for si le wheel and screw driven ferries to be erated by il-electric power Mr Jonas F C vonRosen n the ther hand has placed his dependence up n Diesel e gines alone

It might seem s n ething like an anachronism to retain sid wheels in com ination with an il-electric driv especially when it is borne in mind that paddle wheels are relatively slow moving pro ulsive agencies while the electric motor is most efficient when revolv ing rapidly True the differen e could be harmonized by recourse to a reducti n gear but this invites a mechanical com licati n scarcely warranted in ferry servic The Messrs Dickie have solved their tech nical problem y c n ecting the paddl wheel shaft di rectly with a single large m t r of s ch size that the linear angular speed of the machine will be identical with that f a much smaller motor m king a greater number of revolutions a minute One f the drawings accompanying this article illustrates the magnitude f the proposed motor Theref re th big and com paratively slow turning motor can be depended upon t work efficiently and economically "

Current to energize the motor will be generated by two 500-horsepower 8-cylinder Diesel engines of the non reversible type each f which is to be c upled to a dynamo Both dynamos will furnish electricity to the paddle-wheel m tor and so long as ne of the Diesel

(*Continued on page 52*)

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The President's Great Opportunity

SELDOM, if ever, in history has one man been presented with so sublime an opportunity for doing a work both great and good as that which confronts the President of the United States at the present momentous era in the history of the world

We refer, of course, to the practically universal call which has gone up from a war-weary and war hating world for our President to convene an international conference for the reduction of naval armaments and the prevention of future naval rivalry

It took a world war to drive into men's heads the utter stupidity of settling debated questions by war Whatever the war has left behind it has certainly rooted that conviction in men's minds, and it is there to stay for a long time to come Why so? For the very simple reason that a war of nations, where the whole national strength and resources are engaged, is so exhausting that the victor suffers only a little less than the vanquished

If this be so whence comes the flood of literature attempting to prove that the nations are looking forward to the "next war?" It comes largely from interested people—from defeated enemies and from professional writers who want to make "copy," whether in dailies, in magazines or in the printed book, and who are searching for the sensational They find it in this damnable lie as to the inevitable permanence of war For the writer must write, and the press room is clamoring for its copy Finally, the permanence of war is proclaimed by those ghouls who fatten on the preparation for and the practise of war And, by the way, as far as this country is concerned, these last named are building upon a false hope, for the President it was who said that should another war come, everything and everybody would be conscripted, labor equally with capital Which means that there will be no more cost plus and no more ten to fifteen dollar a-day wage

Do the people of the world want any more war? They do not, certainly not in a national sense In spite of sporadic outbursts here and there, the nations as nations are saying in their heart of hearts that they hate war, and if they can only see the way will make an end of it altogether Publicly their statesmen are saying the same thing in unmistakable terms

So the world has turned to us as the nation which, by virtue of its wealth in men and natural resources, is best able to carry on war and has frankly asked us to take the initiative for peace The people of this country have risen to that cry and have answered that they are for peace and for a reasonable reduction of armaments More than that, both Houses of Congress have voiced this call of the people in a joint resolution, in which the President is asked to call a conference of the three great naval powers to discuss the question of reducing naval armaments.

We do not hesitate to repeat that never in the history of this republic has a President been confronted with a finer opportunity to do a great work for the healing and uplifting of a sorely troubled world If the President should send out the call for such a conference tomorrow, he would do it with the knowledge that not only the people of America but the citizens of the world at large are behind him, and any thoughtful student of the course of international affairs during the past few months, and particularly in the past few weeks, will feel justified in regarding the outcome of that conference with the most confident optimism

In a very real sense and in perfect accordance with history, it can be said that the story of the growth of civilization is a story of the substitution of reason for force, the substitution of the policeman for the soldier, the substitution of the judge for the general, and of the quiet, reasoned utterances of the courtroom for the clash and clamor of the bloody field of battle.

All these changes we have learned to make as between man and man, city and city, county and county, state and state Today, the world is asking itself whether it has the courage and the self-denial to carry the emancipation from war one step further by setting up an international court and pledging itself to abide loyally by its decisions.

Tremendous

WE live in a hectic age. The fever shows itself in diverse directions, and nowhere more than in the written and spoken word. Our forefathers were better balanced, and it can be put down to the credit of the much-despised Victorian Age that its writers were at least moderate in their speech, and had a Victorian habit of using words for their legitimate purpose of conveying exactly the thought that was in the speaker's mind

Not so today, for we are all more or less victims of the germ of what we might call "superlativitis" Take literature, for instance. We find that most of the mediocre writers, and not a few of those who have claims to distinction, seem to have abandoned the positive degree, look askance upon the comparative, and are only at their best—or worst—when they revel in superlatives Things that used to be big are now "tremendous." Things that a mid Victorian would have pronounced to be good are today "superb" A woman with some pretense to good looks who then would be called beautiful has now become a "dream", and so on and so forth It may be answered that this is none of the business of a technical journal, nor would it be if the pestiferous little germ had not entered the sacred fields of science—an invasion which is perilous for scientific accuracy and positively exasperating to the scientific mind

Having thus delivered himself in the general, the editor now wishes to speak in the particular by directing the attention of SCIENTIFIC AMERICAN readers to the positive craze, which, seems to have overtaken not a few technical writers, for using that much-abused word "tremendous" in all sorts of connections in which it should never be found, and where it would be quite easy to substitute some old-fashioned Victorian adjective which would exactly express the truth. Whence comes this habit of exaggeration? If our beloved Mark Twain were alive today he might say that since "all men are liars," a listener, in the endeavor to get at the truth of a statement, puts a discount of 50 per cent on what he hears, and a speaker, if he wants to get his meaning into another man's mind, must overstate his case about 100 per cent Be the explanation what it may, there is a deplorable tendency to adjectival exaggeration, of which the misuse of the word tremendous is just now the most glaring example

Now the dictionary defines tremendous as follows "such as may or does excite trembling, fear or awe, overpowering in character or quality, awful, dreadful as a tremendous explosion, tremendous invective" By way of illustration, the dictionary quotes Macaulay as follows "The battle of Ravenna, one of those tremendous days into which human folly and wickedness compress the whole devastation of a famine or a plague"

Now, the desire on the part of the scribe to put "snap" or "ginger" or "pep," if you will, into his writing even if the subject be a serious scientific or technical one, is perfectly proper, but he should never try for this result by meretricious or misleading means. For instance, if a sudden freshening of the breeze raises the speed of the Cup defender, "Resolute," from ten to, say, twelve knots, it is perfectly proper to speak of her showing a fine burst of speed, but it is ridiculous to say that she showed a tremendous burst of speed If a yacht designed to make twelve knots on a reach in a fairly smooth sea succeeds in doing that, there is nothing tremendous about the exploit. The San Francisco earthquake was tremendous, tremendous was that blast of hot gases which swept out from the ruptured peak of Mount Pelee, and in a moment wiped 30,000 men, women and children off the face of the earth. The World War, with its loss of ten million lives and 200 billions of wealth, was tremendous. Indeed, the only thing tremendous about this widespread misuse of a great adjective is the tremendous scale upon which the folly is being perpetrated. For the vice is spreading, and we have been amazed to find how greatly the abuse of this word is marring the work of some of our best contemporary writers.

By all the rights of the thing, when a man sits down to breakfast and announces that he has a tremendous appetite, there should be a sudden flight from the table; for to do justice to the term he should not only eat his own breakfast, but make short work of father, mother and the whole family group. That would be a tremendous appetite!

And, gentle reader, do not come back at the editor and say that he is pushing the thing too far, that the adjective in such cases is used in a hyperbolic and exaggerated sense, as everybody well understands. We admit that in this last example the point is fairly well made But so is our point, that when a language so rich in its vocabulary as the English, provides an ample supply of words that will exactly and truthfully convey the intended meaning, it is a vicious practise to reach out for words which express much more than the speaker really intends. If an invention is destined to take a useful place in the arts, do not speak of it as having tremendous importance in those arts. If you wish to point out that a certain structure is not quite as strong as might be desirable, do not say that the designer took a tremendous risk in building the way he did Furthermore, it is a complete misuse of the word to say that so and so, or such and such a device has a tremendous opportunity for usefulness. There is nothing to "excite trembling, fear or awe" in the contemplation of widely-extended usefulness. Quite the contrary.

The State's Duty to Its Barge Canal

THE State of New York has built a very fine barge canal between the Great Lakes and the Atlantic Sea In this great effort it has expended over 160 millions of dollars of the State funds, and there, unfortunately, it seems content to let the matter rest Consequently, the barge canal is doing only a small fraction of the carrying trade of which it is capable Not only is the canal able to carry a very large percentage of the total freight which moves from the Great Lakes to the coast, but it can carry this freight at materially lower cost. Proof of this is found in the fact that the General Electric Company at Schenectady has built its own barges and by means of these it is shipping freight at a cost 20 per cent less than it can ship it by rail.

It must seem strange to thinking people that in these days when every one is endeavoring to cut down costs of production and of delivery to the consumer, a water way like this, capable of carrying freight cheaper than the railways, should be doing so little work. The reason is to be found in the fact that during the period of many years covered by the construction of the canal, there was but one way for the manufacturer and the farmer to ship their goods, and that was by rail. Consequently, the people have got into the habit of thinking and figuring in terms of the cost of rail transportation They have yet to be taught to think in terms of canal transportation. In other words, there is need for a good old-fashioned campaign of advertisement, in which the shipping public must have put before them the capacity of the canal and the fact that it can carry freight from the Lakes to the New York terminals, not only cheaper than railroads, but on an average, in equal time These facts should be made known through the press and in that varied and very effective form of pamphleteering which has been developed into an art by the modern advertising expert.

And this work of advertising the canal should be done by the State itself; for this is a State work, built for the development of the State, which lacks today only the thorough-going backing of the State in the way we have indicated to make the enterprise the success which it deserves to be and, we firmly believe, will prove to be, if the State will lend its influence to a legitimate, well-thought-out and persistent educative propaganda.

Electricity

Hydroelectric Plants for Japan.—It is understood, states an issue of *Finance and Commerce*, that a plan for the construction of nine hydroelectric plants to use the waters of the Sho and the Chigusa Rivers is being considered by the Hyogo Prefectural Assembly It is proposed to begin construction in 1921 and to complete three plants every two years until 1926

New Type of High Resistance.—In a recent issue of *Zeitschrift für Technische Physik* there is a description of a new type of high resistance The resistance consists of a thin layer of graphite wound round a glass spiral. A convenient way of mounting it is to attach it to the stem of an ordinary electric bulb which is filled with hydrogen to facilitate the conduction of heat. Sample resistances, varying from about 8×10^{2} to 3×10^{4} ohms, have been tested and found to be very constant. They are capable of taking up to 1 watt per square centimeter of graphite surface for continuous loads.

Automatic Converter Stations.—A recent article describes in detail the Brown Boveri system of automatic single-armature converter stations. Such automatic stations seem destined to play an important role in future conversion and distribution work, as by installing separate converter stations close to the main feed points, great saving can be effected in conductors, voltage regulators, etc, and with automatic stations no permanent staff is needed. Starting, stopping, restarting after interruptions, alarms and permanent disconnection in case of uncleared faults, are all carried out by means of a combination of time switches, relays, contacts and distance controls.

Experiments on Residual Charge. — Investigations of residual electrical bi refringence having led to the observation of a residual charge in condensers in a spark circuit, an experiment was undertaken to show the residual charge of dielectrics, particularly glass. The experiment, continues *Revue Generale de l'Electricite*, was carried out with a Leyden jar charged by a small Ruhmkorff coil across a point-disk gap A water rheostat and a Geissler tube were shunted across the condenser The coil circuit was momentarily closed, a spark obtained across the tube After the circuit was opened, a series of residual sparks could be observed in the dark, occurring at increasing intervals of time The number and spacing of the sparks depend on the resistance

The Storage Battery at Its Best.—It is remarkable that storage batteries can be used and abused on automobiles in the way they are in every-day practice Years ago it would have meant a very short life for any storage battery submitted to the gruelling service of automobile starting and lighting. Every time the engine is started on the average automobile, anywhere from 80 to 80 amperes is drawn from the storage battery—a very heavy drain, to be sure Often, too, automobile storage batteries are discharged considerably below the safe point, yet these batteries somehow hold out. Also, they are often overcharged for long periods without immediate harm The wonder of it all is that the average storage battery gives such long service under the circumstances.

Electrical Analysis of Aluminum Ore.—An important discovery, a new method of extracting aluminum from a certain mineral, which affects the future development of Japanese industry and the formulation of an established air policy of the Japanese Government, is the result of the investigations which have been carried out by the experiment station on the production of aluminum and its compounds. A great refinery plant driven by electric power is to be established at Yoyogy A project is under contemplation to establish a semi governmental company for the manufacture of aluminum by the new method, which consists in the electrical analysis of ore by Korean alum and other materials and enables the production of more than 90 per cent of aluminum.

Pintsch Lamp for Switch Circuits.—If two metallic electrodes are introduced into a glass bulb containing a rarefied atmosphere of neon or helium and a direct-current voltage of at least 160 volts is impressed upon the two electrodes, the negative pole will emit a distinctly visible light, which at about 220 volts becomes so bright that such a lamp may be used advantageously for signal purposes on switches and similar apparatus. On alternating current both electrodes show the light emission. A great variety of such lamps were recently introduced by the Julius Pintsch Company of Berlin. Parallel with a fuse, such lamps detect and show a burn-out. They will serve as a position indicator for switches or as a distant indicator of the condition of a motor. These lamps have many different applications other than those already mentioned.

Science

Lo the "Poor" Indian.—Owing to the sale of valuable oil lands in Oklahoma approximately 2,000 members of the Osage tribe will receive an annual income of $10,000, and the Osage Indians become the richest people in the world per capita

Best Wire for Pictures.—They have recently been experimenting in England on the best support for pictures and it was found that plain copper wire in one strand is far superior to twisted brass wire, and copper wire is, of course, not liable to rust.

A Bird Sanctuary for Gulls. — Natural history has many students in Canada proper and the provinces. The town of Yarmouth, Nova Scotia, has recently purchased an island in its local Lake George as a bird sanctuary for great black backed gulls

German Emergency Cook Book.—One Magda Trott has written a cook book giving recipes for substitutes for food or food substitutes used during the emergency that followed the outbreak of the late war It is called "Kochbuch mit 600 Kochvorschriften aus Knappen Tagen"

The Purification of Olive Oil.—The disagreeable bitter taste acquired by olive oil is due, probably, to the decomposition of albumoid substances By heating the oil to 100 degrees Cent, these latter substances will be coagulated and may then be readily removed In order to remove the free acid fats it suffices to agitate or shake up the oil with lime water

Popularizing Mathematics.—At the summer session at Columbia University an attempt will be made to show teachers how to make the study of mathematics attractive If the same effort had been made years ago to popularize mathematics as was expended on chemistry we would have more people with a mental background capable of understanding Einstein, which is by the bye to be included in Columbia for the first time in a college curriculum

Greek Art for Poor Children.—To impress the value of the classics on young and poor children the University Settlement House at Beacon, N Y has erected a mansion whose porticos are representations of the Parthenon and the Erechthium at Athens One façade is built on the Ionic order and the other the Doric order So now the beauty starved boys and girls from New York's great East Side can play and live under the shadow of the great examples of Greek architecture —even if they are executed in pine

Three Killed by Radium's Effect —The death of three persons connected with the Radium Institute, which at first was declared to be directly caused by their proximity to the radium, has been found to be only indirectly the result of their work An investigation recently completed showed that while the three victims died from ordinary disease it was their power of resistance that had been undermined by their work with radium Every member of the Radium Institute was affected by the presence of the radium Each of the three who died was suffering from anaemia when attacked by other diseases and therefore they were in no condition to resist the illness

The Oldest Auto Still Running.—Paris is used to unusual sights, and a few days ago the populace was treated to the sight of the venerable great grandfather of the automobile The owner, the Abbé Gavois, who was perhaps the first professional man to recognize the value of the automobile for getting around the country for pastoral or other duties, managed the creaking old contraption. He was greeted with salutes of horns throughout his progress through the city The long visioned Abbé is looking to sell the historical machine and the proceeds will help the poorer clergy of his district The "car" has not been overhauled in thirty years and barring a touch of asthma is still runable

Sweet Potatoes for the Candy Manufacturer.—By a roundabout process the sweet potato is to be turned into an important raw material for the candy maker The succulent southern tuber is, of course, first turned into syrup and the candy follows in due course, for, contrary to the usual belief, not all candy is made from sugar, syrups forming an appreciable part of the supplies. The increased use of the sweet potato will be a boon to the not too prosperous Southern farmer as it will enable him to diversify and rotate his crops, and if the cotton or tobacco crop is bad will tend to equalize the losses, for sweet potatoes are easily grown The molasses factory will take the "sweets" and turn them into syrup, giving the farmer a much higher profit from his crop. The factories will be located in sections where the sweet potato is most easily grown, and this will give the farmers of those sections a new line of profitable agricultural endeavor.

Astronomy

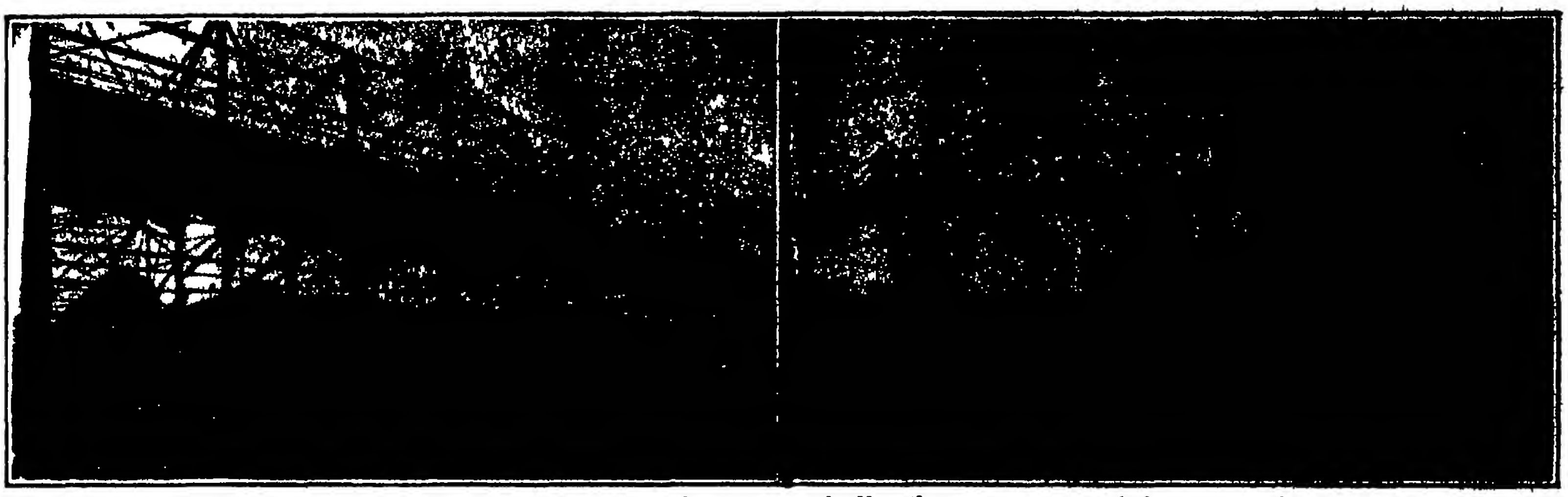
An Exceptionally High Solar Prominence, observed October 8, 1920, was described at the last meeting of the American Astronomical Society by Mr Oliver J Lee, who presented the results obtained from a study of 57 photographs taken of this eruption The crest attained the remarkable altitude of 531,000 kilometers The highest velocity observed was 155 kilometers per second The photographs reveal many peculiarities of motion The head of the prominence separated into parts, which continued the upward course unchecked, while other parts reversed their motion and fell back upon the sun

Observation of the Gegenschein in London.—In the memoirs of the British Astronomical Association it is recorded that Dr W H Steavenson saw the gegenschein from his garden in Norwood on the night of Feb 5, 1916. He describes it as not quite half as bright as the Milky Way in Monoceros. It was oval, about 8 by 15 degrees, with long axis parallel to the ecliptic So far as known, this is the first time the faint object in question has ever been seen from a London suburb, and the observation was possible only owing to the lights of London being extinguished for military reasons.

Extension of the North America Nebula.—A photograph of the region including the well known North America nebula, taken by F Henroteau at the Dominion Observatory, shows a very large extension of this nebula, covering an area of 10 5 square degrees, as compared with 1 6 square degrees, the area of the North America nebula proper The photograph was taken Oct. 10, 1920, with an exposure of 3 hours The great transparency of the sky at the time of exposure and perhaps a greater sensitiveness of the plate for light of favorable regions of the spectrum, are responsible for the detection of the larger nebula.

A Defect in Astronomical Photographs.—In measuring the distance between neighboring star images and spectral lines on the photographic plate some account must be taken of the tendency of the photographic process to make these images approach or recede from each other, in consequence of turbidity, gelatin disturbance, developer action, etc Mr Frank E Ross has recently reviewed the literature of this subject and reported the results of his own experiments on the behavior of artificial double stars, close bright lines and close absorption lines. He finds that important differences develop depending upon whether the exposures are normal or overexposed The contradictory results obtained by various investigators are thus explained With overexposure, strong repulsions of neighboring images are found, except in the case of absorption lines, in which a strong attraction is found In the case of normal exposures, an attraction between the images is usually found, amounting to two or three microns. In order to reduce this effect, the exposure should be reduced to a minimum In the case of overexposures, considerable variation in the repulsive action was found by varying the developer A further study of developers is desirable in this connection

Recent Observations of Well-Known Novæ. — Most of the new stars that have appeared in past years are still visible with large telescopes, and the study of these stars in their fainter stages has been for some years a part of the program of the 40-inch Lowell reflector Mr C O Lampland has recently published a summary of these observations, carrying the history of the novæ down to the latter part of the year 1920 The magnitudes given in the following extract are photographic. *Nova (Q) Cygni, 1876* Only small variations of light noted on the photographs, present magnitude about 15. *Nova (T) Aurigæ, 1891* Light nearly constant in recent years, magnitude now about 14 7 *Nova Persei, 1901* This nova has undergone marked fluctuations of brightness between Feb, 1917, and Dec, 1920, the observed range being about two magnitudes (13-15, approximately) The wisp of nebulosity near the nova discovered by Barnard in 1916 has been photographed frequently at Lowell Observatory The nebulosity is moving away from the star at the rate of a quarter of a second of arc a year, or a little more, its form has changed slightly, and there is an appreciable increase in its width *Nova Geminorum 1, 1903* This star is gradually and slowly falling off in light and is now fainter than magnitude 16. *Nova Lacertæ, 1910* Quite constant in recent years, magnitude now about 14.5 *Nova Geminorum 2, 1912* Small fluctuations have been noted, but the light is gradually becoming fainter, present magnitude about 13 5 *Nova Monocerotis, 1918* In March, 1918, it was near magnitude 10, in November, 1920, it was a little fainter than magnitude 15.



Left: Battery of kilns for burning the lime used in extracting potash from green sand. Note the man near center of photograph, giving a comparison for size.
Right: Giant crane employed for many purposes at the New Brunswick green sand reduction plant

Putting Green Sand to Work

How the Hitherto Untouched Glauconite Deposits Will Insure Our Future Potash Requirements

By R. Norris Shreve

FROM the neighborhood of Atlantic Highlands, New Jersey, as far down our east coast as Virginia, in several places crossing the shore line, are found vast deposits of a dark material called green sand. There are millions and millions of tons of this substance in the state of New Jersey alone, and while the farmers did once upon a time use it as a fertilizer, they abandoned it fifty years ago. In truth, until quite recently it has not been regarded as of any more, if even as much, value as the ordinary sand of the seashore. The only marketable use for it was to put it in small vials and sell it to the customers of the curio shops at the Jersey seaside resorts, and such sales were not numerous enough to exhaust the deposits in several million years. So it was a drug on the market.

But within recent years this curious dark green mysterious sand has assumed a real importance as it has been found that it can be made of great value to farmers. If this had been known before the war the difficulty experienced by our farmers in producing their crops when the German potash supply was shut off, would never have been encountered, for it has been determined that this green sand contains enough potash to supply every need of the American farmers for the next thousand years.

Here is a touch of romance! While our agriculturists' principal cry has been for more potash so that the globe can be made richer, our crops be more abundant and the cost of living lower, and while Germany to meet this demand has been selling thousands and thousands of tons of this substance to this country, at our very door all the potash we could possibly use and much more has been lying idle.

The story of this green sand sounds like an Arabian Nights' tale. Ages and ages ago the deposits were built up slowly underneath the waters of the sea, the process continuing for millions of years. Gradually as the ocean receded they emerged from beneath the waters and became dry land, and there again they lay slumbering for ages undisturbed and almost unknown until they suddenly emerge as a veritable gold mine for economic productivity and a real boon to the American farmer.

While as previously stated the great belt of green sand extends from the neighborhood of Atlantic Highlands, New Jersey, far down into Virginia, and is easily reached from the surface, it is in New Jersey that most of it is found. Enterprising men, realizing the possibilities of green sand, are building a large factory at New Brunswick, N. J.

Besides the purest potash—one of the three constituents of fertilizers—the experiments have revealed that the green sand can also be made into the finest brick, and the plant where the green sand will be handled actually has been built of this brick.

As the most promising source of potash in the eastern section of the United States the green sand deposits came in the nick of time to fill the crying need for the development of our own fertilizer industry. The war had completely cut off America's chief source of supply, Germany, and we were in serious danger agriculturally speaking, until the happy thought of three men, who invented a process for utilizing the green sand which makes this country's potential potash supply staggering in proportion.

The United States uses 250,000 tons of potash a year, and the United States Geological Survey has estimated that a square mile of green sand one foot thick will yield 78,000 tons of potash. A twenty-foot bed that covers a square mile should yield 1,500,000 tons of potash, or enough to last the entire country for about six years.

During the period when the green sand was formed a great number of prehistoric animals inhabited the earth and sea, and the remains of these animals occur in the material which is now being made into potash. Indeed one authority says that the sand is nothing more than accretions or deposits that were built up during the decay of countless billions upon billions of microscopic animals, which as they died, fixed the potash for a future age to use. Skeletons of numerous reptiles together with fossil shells and the remains of the microscopic animals, give the searcher of today a picture of the teeming life of those past ages.

After the death of the minute organisms, their shells were slowly filled with the fine potash bearing mud in which they were deposited. The potash from the mud and the sea water accumulated in the shells which finally disintegrated and became decomposed until the phenomenon of green sand appeared, which eventually was raised up from the sea bottom to dry land, forming what is mineralogically called green sand, or glauconite.

The discovery of the commercial value of the green sand came about in this way. During the war search was made everywhere for potash-bearing minerals, and T. C. Meadows, an experienced fertilizer chemist, knowing of the old but long-abandoned potash fertilizing value of the green sands, decided to see what the skill of the chemist could do toward unraveling the wealth of potash stored up for so many ages. Samples of green sand were obtained and were subjected to chemical processes by Mr. Meadows and his associate chemist, Mr. H. W. Charlton, and they found that it worked splendidly—very much better, indeed, than the other minerals that they had tried. They realized that their search was ended. The problem then became one of inventing a process for releasing the potash. This was evolved after considerable experimentation at a small plant at Jones Point, New York, where a third chemist, the writer, was called in to assist them. There the problem in all its phases was considered.

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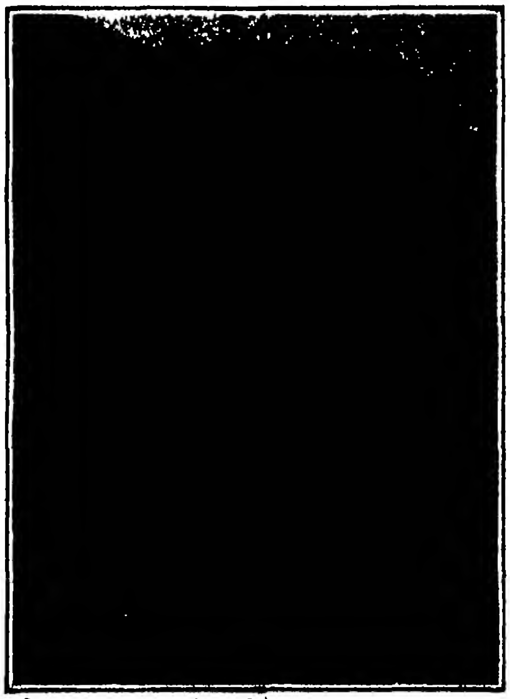
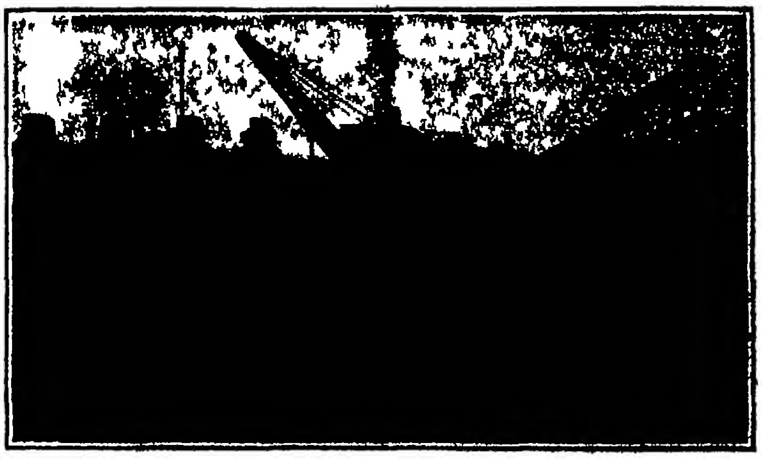


One of the four giant three-story evaporators to be used in the concentration of potash extracted from green sand



A steam shovel of the type that will be employed in mining the green sand deposits

Our Latest Battleship, the "Maryland"

By C. B. Wagoner

WHEN the super-dreadnaught, the U. S. S. "Maryland," steams out of Hampton Roads, early in November and points her clipper bow toward the sea for her official government trials, the nation will hail a new pride of the Navy and the Navy itself will acknowledge a new Queen of the Seas.

The "Maryland" is in every respect the latest completed achievement of American naval architects. Carrying eight 16-inch guns, the largest ever mounted in a battleship, she will be the most powerful fighting vessel in the world. These mammoth guns, located in four turrets of two guns each, fire a shell weighing 2,100 pounds for an extreme distance of more than 20 miles. The guns are over 60 feet in length and for each full charge approximately ,480 pounds of powder are required

The secondary battery, consisting of fourteen 5-inch guns, is carried for use against torpedo boats, submarines and other smaller craft The ship has also four 3-inch anti-aircraft guns, a 3 inch landing gun, six .30 caliber machine guns and two underwater 21-inch torpedo tubes for firing the largest and longest range torpedoes.

The "Maryland" possesses all the latest provisions for protection against torpedo attacks. It is claimed by naval architects that it would require several hits by torpedoes to sink the ship by an under-water attack The crew and vital parts will be protected by armor plate so thick that only the largest caliber shells, fired at moderate range could get through.

Displacing 32,600 tons, this fine warship, electrically driven, will have a speed of 21 knots and a cruising radius of 10,000 miles. She will burn oil, her fuel capacity being approximately 1,400,000 gallons.

The "Maryland" is 624 feet long and has a beam of 97½ feet. There will be 67 officers in the ship's complement and more than 1,400 men in her regular crew

This most modern of warcraft recently completed her builders' trials with a perfect record For 38 continuous hours at sea off the Virginia Capes, she was put through all sorts of tests, bringing into

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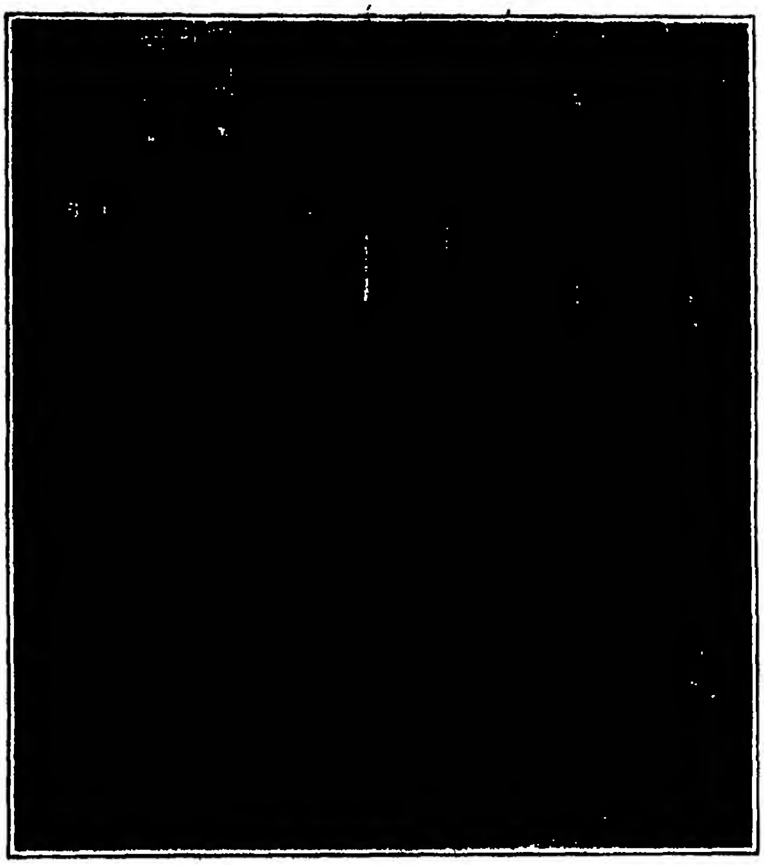
The "Maryland"—the first United States battleship to mount a 16-inch gun



Control levers and instrument board comprising the propulsion control equipment of the "Maryland"

Something New in Salvaging Equipment

By Harry A. Mount

THE almost successful raising of the wreck of the yacht "Isis," off St Augustine, Florida, by a New York salvage concern, using ingenious but hitherto untried equipment, designed to reduce greatly the time and expense of salvage operations, suggets a possible revolution in the methods of this branch of marine engineering The 'Isis' was recently freed from the sticky bottom of the Atlantic and raised five feet, but storm and chafing damaged the pontoons. As soon as new equipment is obtained the work is to be resumed

The equipment was designed by A B Salinger, an electrical engineer It consists essentially of a number of electrical burrowing machines or "moles for carrying a cable through mud or sand under a sunken vessel equipment for controlling these "moles,' and a new type of collapsible pontoon for raising the vessel

Aside from the trial given this new equipment, the attempt to raise the "Isis" is of interest because she was once before raised and lost again through overconfidence of the workmen The "Isis" was, before the war, the sumptuous private twin screw yacht of A G Spalding, and is said to have cost $800 000 She was built in 1902 at Newburgh, N Y, and measures 180 feet in length She was taken over by the Government in 1915 and assigned to the Coast and Geodetic Survey In February 1920, while on the way to South America, she struck a submerged dredge off St. Augustine and sank in 40 feet of water

The Government sold her as she lay to a salvage concern and the vessel was raised by ordinary salvage methods and beached while temporary repairs were made Confident that the work had been well done, the salvagers moved their effects aboard and two tugs started towing her to port. But the temporary repairs proved inadequate and finally, to save themselves, the two tugs cut their lines and let her sink again in about 20 feet of water The bottom at this point is sandy and the boat sunk with one side buried deep in the sand Because of this fact a second raising promised to be both difficult and expensive The wreck was

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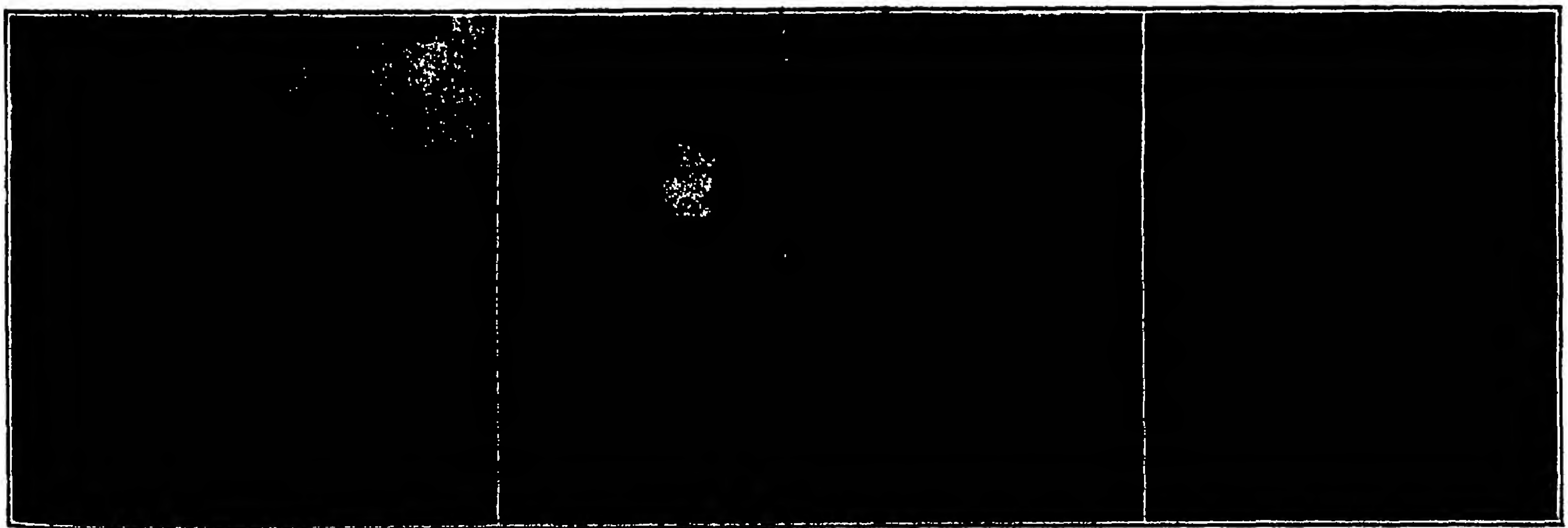

Left: The control board mounted on a boat at the surface, from which the burrowing machine is operated. *Center:* One of the resilient pontoons fully inflated, which is claimed to have a lifting capacity of [illegible] tons. *Right:* The electric burrowing machine which digs its way through mud and sand by means of a pair of electrically-driven propellers or cutters and is directed by electrically-operated rudders

Essentials of a new salvaging system which depends on the use of an electric burrowing machine and inflated bags for pontoons

How Much Air for the Tunnel?

Solving the Vehicular Tunnel Ventilation Problem with the University of Illinois' Miniature Test Duct

By George H. Dacy

There are 224 air outlet ports in the experimental duct, which admit of the study of the wide range of ventilation conditions in the tunnel

WITH the inception of the Hudson River vehicular tunnel project, a ventilation problem arose the like of which never before confronted the engineering profession A previous article published in the May 8, 1920 issue of the SCIENTIFIC AMERICAN discussed in detail the plan of the two proposed subterranean tubes twenty nine feet in diameter and 8,300 feet long between the portals which are designed to carry two lines of traffic in each direction estimated at 1,900 vehicles an hour Construction work has begun It is estimated that the tunnels will cost more than $28,000,000, while it will take five years of intensive work to build them

We know that motor cars seldom—if ever—develop complete combustion, this results in the production of a varying percentage of unsaturated hydrocarbon and carbon monoxide in addition to carbon dioxide in the exhaust gases. Carbon monoxide is poisonous and the problem arose of determining how much the exhaust gases must be diluted in order to render them harmless to the motorists who would use the tunnels

A technical explanation of the effect of carbon monoxide on human metabolism features the fact that this active poison has an affinity for the hemoglobin of the blood much greater than that of oxygen The blood absorbs carbon monoxide more readily than it does oxygen and where the blood is saturated with the poisonous gas, its ability to transport the essential oxygen to the organs and tissues of the body is seriously reduced Extensive experiments have been conducted by the U S Bureau of Mines Experiment Station at Yale University to ascertain the proper dilution by fresh air ventilation which would render the obnoxious carbon monoxide gases harmless In these tests which were performed in a special gas tight chamber scientists spent periods of one hour in amounts of carbon monoxide varying from two to ten parts in 10 000 Other experiments were conducted in a large chamber of 12 000 cubic feet capacity so arranged that an automobile engine was exhausting its by product gases directly into the gas-tight chamber It was demonstrated conclusively that under conditions of a dilution of 4 parts or less of carbon monoxide to 10,000 parts of air that no inconvenience or disagreeable results attended Even where the dilution was only 6 parts in 10,000 no bad effects resulted, although where the proportion was 8 parts in 10,000 the observers reported that they suffered from distinct headaches caused by the poisonous vapors Motorists in cars going through the tunnel in 10 to 15 minutes will experience no bad effects whatever and will absorb very little gas according to the ventilation scheme which has been devised

It was next found essential to conduct additional experiments regarding the most efficient methods of ventilating the tunnel so as to engender and maintain the proper flow of fresh air into the tunnel as well as to provide for the efficient disposal of impure air In these interesting and novel experiments, the University of Illinois engineering college has cooperated with the Federal Bureau of Mines in the construction of a novel, miniature tunnel on the campus of the Illinois institution, which for investigational purposes could be used interchangeably as a fresh air supply duct or an exhaust air duct. This is the most important single experiment ever conducted by an engineering school relative to the determination of the coefficient of air friction, essentially a physical property The duct, which is 400 feet in length, is made of concrete and is an accurate representation of the lower and upper ducts which ultimately will be constructed in the Hudson River vehicular tunnel, with the exception that the trial duct was built to the scale of one-half dimension and one-fourth the area of the permanent tunnel ducts.

One of the four test stations along the experimental duct, where investigator utilizes delicate recording apparatus to determine results

The experiments with the trial tunnel will cost approximately $50,000, and they represent an entirely new and unexplored field of technical engineering Information has emanated from these unique scientific researches which is worth millions of dollars to cities which potentially will construct vehicular tunnels. This experimental work has resulted in the accurate and conclusive determination of the coefficient of friction of the flow of air in concrete ducts—facts and figures concerning which scientific and practical engineers, heretofore, have had no knowledge. The tests have also resulted in the complete verification of the formulæ used in the computation of power required for moving air through a duct from which air is taken off at intervals. They have been responsible for the determination of the power and frictional losses of ventilation air in the turns and bends of ventilation equipment and tunnel accessories. They have permitted of a careful and complete study being made of the diffusion of exhaust gases in the cross section of the tunnel and an investigation of temperature conditions in the proposed tunnel as affected by the operation of internal-combustion motors. They have facilitated the study of physiological effects of temperatures, exhaust gases and smoke in the tunnel sections under operating conditions.

In the test tunnel sector, the distributive method of ventilation has been used, the fresh air being supplied at all points throughout the tunnel, while the amount of air provided at any particular position can be controlled Furthermore, there is no discomfort or danger from high velocity air currents which are objectionable in tunnels where the longitudinal system of ventilation is practical According to the methods pursued in the Illinois experiments the ventilation of the tunnel will never be affected by moving traffic nor the direction of the wind It emphasizes the rapid removal and efficient dilution of the exhaust gases.

According to the engineering experts in charge of the new Hudson River tunnel, the power required for moving the air through the ducts increases very rapidly with their length, so that it is important to make them as short as possible

To minimize the operating costs, each tunnel will be equipped with four ventilating shafts, two located near the pierhead line and the others about midway between these and the portal. The equipment in the shaft superstructures will furnish ventilation half-way to each of the adjacent shafts. On the basis of the experimental data available at this writing, the authorities in charge of the construction of this modern Goliath of underground passageways estimate that approximately 65 large electrically-driven fans ranging from 100 to 600 horsepower apiece will be required to insure a full air supply at all times and to allow for untoward emergencies. The fresh air will be fed to the fans through open louvres in the sides of the buildings while the vitiated air will be exhausted through vertical stacks.

The circular tunnel provides space above and below the roadway for air ducts. Practical tests and experimental data indicate that the advisable location of these ducts is with the fresh air duct under and the exhaust air duct over the roadway. The fresh air coming from the blower fans at the shafts is discharged from the main duct through

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The 400-foot long test duct at Champaign, Ill., built on the basis of one-half size and one-quarter area as compared with proposed Hudson River vehicular tunnel

Drying Wood in the Orient

THE method employed in drying wood in China and Japan is shown in the accompanying illustration. Bamboo stakes are driven into the ground and the planks laid between them so as to prevent the wood from warping during the drying operations. A similar method is employed when it is necessary to shape the planks or other pieces of wood.

Helping the Automobile Out of Sand with Chicken Wire

CHICKEN wire laid over deep and shifting sand provides almost perfect traction for the automobile, according to a San Francisco motorist who demonstrated the value of chicken wire for this purpose over a sandy stretch that otherwise could not have been negotiated.

A seven-passenger car was driven into deep sand until it would not move forward another inch. A roll of chicken wire was unwound and one end placed under the rear wheels. The car was then easily backed out of the sand. To drive forward in sand it is necessary to spread the wire in front of the car so that the rear wheels will have traction the moment they touch the sand. The wire must be at least two feet wider than the distance between the right and left wheels. The longer the roll the farther the car can be driven over sand without going through the operation of shifting the wire from back to front of the car.

Members of the party that witnessed the demonstration expressed the opinion that no tourist traveling any distance where he was likely to get stuck in soft sand or mud could afford to be without chicken wire in his equipment. The best size and method recommended is a piece of wire about three or four feet wider than the car and two or more times the wheel base. On account of the extreme flexibility of ordinary chicken wire, a piece this size could be folded once or twice and then rolled up. In this form it could be conveniently carried. When needed it would save much hard work and grief and might well repay the owner of the car for the cost of getting it and the trouble of finding space and carrying it.

The Crawling Yard Crane

A DISTINCTLY new application to industry of the war-time tank tractor is the crawling crane as illustrated. It is the ordinary yard or locomotive crane, used so extensively in large industrial plants, and made more useful by applying to it the mechanical locomotion used by war tanks.

The new device is put on the market by a Chicago company. A feature is that it can turn around in any one spot or in the circle of a radius about equal to its own length. The steering is done from the cab by brakes on the differential shaft which is said to enable this unusual radius of action. Its superiority to the older cranes operated on wide and narrow gage tracks is readily understood. The crane is made in two sizes, 7-ton with 30-foot boom and 12-ton with 35-foot boom. Besides the crawling tread, it can be arranged to operate on broad-faced road-wheels or on standard or special-gage tracks.

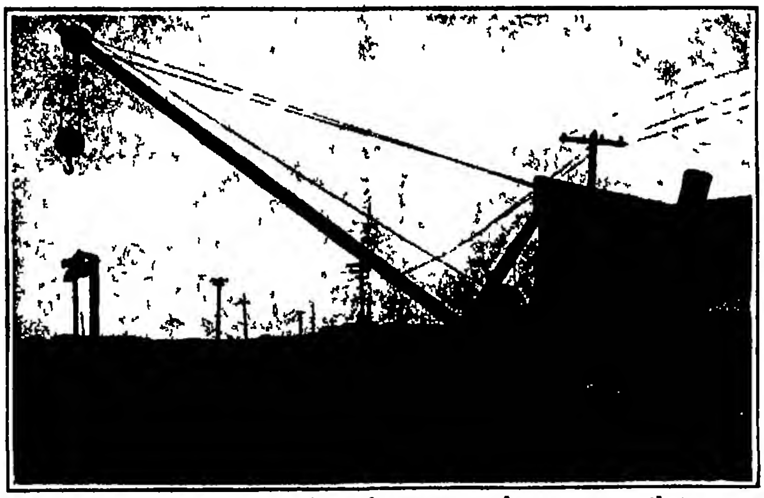
Reconstructing the Jutland Battle for the "Movies"

THE recent war has been thoroughly recorded for posterity. There is no doubt about it, for books, documents, photographs and motion pictures are available on practically every detail of the great conflict.

The latest contribution to the rather voluminous motion picture records of the war is an ingenious film depicting the naval Battle of Jutland, and recently produced in England. The stirring battle was reconstructed with infinite care and accuracy by means of miniature battleships, and animated for the motion picture film in the manner generally followed in producing trick pictures. The reproduction of a moving bird's-eye view of the Battle of Jutland for the films proved to be an immense task, we learn from *The Illustrated London News*. The work was carried out according to track charts prepared by Sir George Ashton, by a British film company, on a board measuring 8 feet square, as shown in our cover illustration. The model ships were made in three sizes—4 inch for close-ups, 2 inch for medium shots, and 1 inch long for long shots. Ships, "sea" and "sky" were painted in shades of gray. Gunfire and explosions were produced by blowing smoke through pipes. For each picture each model had to be moved only 1/16 of an inch. There are sixteen pictures to every foot of motion picture film, hence the passage of the Grand Fleet across the North Sea required 90 feet of film, and 80,000 separate movements by hand of the models. That of the German fleet required 60,000 movements.

Drying planks in China and Japan without danger of warping by means of upright bamboo stakes

Using a roll of chicken wire to help the automobile over sandy stretches and out of sand- and mud-holes



A highly useful combination of crawler tractor and power crane that can go anywhere in the plant yard or railroad terminal

Electrically-operated scale that shuts off the flow of material when proper weight is attained

Eliminating the Overweight Evil to Save the Profits

OVERWEIGHT in the selling of merchandise of various classes has been the cause of many stores' profits being reduced. In some cases, the profit is actually wiped out completely. Thus while merchants have been backward about buying new and sometimes expensive equipment, they have been eager enough to purchase when a demonstration proved to them that they were paying for the equipment under the old methods, but not getting it.

A week's test of a pair of automatic scales proved to a hardware merchant that he was losing on an average of $1.44 in profits per day as he used the ordinary scales. Some of his lines, rope for instance, showed a loss, being sold so closely to the cost price. In order to demonstrate, the agent for the automatic scales placed the improved scales beside the old pair, and as a package was weighed on the old a comparative weight was obtained from the new scale. Under those conditions the salesmen were as careful as possible, yet the loss in overweight was proved.

One hardware merchant figured that he was getting but 95 per cent of the price of the nails he was selling due to loss as they were weighed into bags as purchased. He soon devised a safe method. Each hundredweight of nails of each size was given to a salesman with instructions to fill a certain number of pasteboard cartons, the cartons being of various capacities, but the total amounting to 100 pounds. There could be no overweight. The plan not only paid for the cost of the cartons but the weighing device as well, and increased the profits.

Another late weighing system that saves both time and labor is that used by the Colorado Springs, Colo., food merchant shown in the accompanying illustration. He has saved floor space by keeping his stock bins for teas, coffees and spices on the second floor from which the spices and so forth run down into glass-fronted cases above the wall ledge. Under each spout outlet for these cases is a button. As a customer orders spice from any certain case the scales are pushed under that case, the proper weight is indicated on the scales and the paper bag is placed on the upper or lower flange according to its size. The scale is then pushed back into the crescent opening allowed for it where it touches an electric connection. The lever is pulled to release the stream of spices. The scale pan on the side carrying the filling bag drops and as it reaches the center or balancing point the electric current is automatically shut off and the stream stopped at the proper quantity.

The Oil That Makes the Wheels Go 'Round

Animal and Vegetable Lubricants vs. Those of Mineral Origin Today and in the Future

By Harry A. Mount

LAST year and the year before, when we were all so concerned over the apparently imminent exhaustion of our petroleum deposits, the chief concern was felt with regard to the fuel of the future for internal combustion engines. Comparatively little attention was paid to the fact that not alone the automobile, but all engines and machinery of every description, are largely dependent upon petroleum derivatives for lubrication. Now that the price of gasoline is declining so steadily and even so rapidly, we are apt to think that all the problems connected with petroleum production are permanently solved. That this is not the case, that it is necessary for us to pay serious regard for the future supplies of lubricant, is Mr. Mount's text in the story on this page.—THE EDITOR.

ATTENTION has often been called to the fact that our decreasing production of petroleum menaces a vital fuel supply and it has further been pointed out that we are dependent upon this source also for lubricants without which modern industry would be quite as helpless as though without fuel.

Much concern has been expressed over the fuel situation, principally because those who own motor cars (and they comprise a large part of the population) have already felt the pinch of scarcity. But, as a matter of fact, the fuel problem is not without its brighter side while that of a future supply of lubricating oils, in many of its aspects is much more serious.

It has been demonstrated that we need not wait while buried vegetable matter goes through countless ages of transformation before there is available the fuel we derive from petroleum. Nearly any growing plant, when subjected to a simple process of fermentation and distillation, yields a fuel alcohol, which when properly prepared is as good as gasoline, or even better, as a fuel. But is not the same thing true of lubricants? What of the great variety of oils and greases which are now obtained directly from plant growths and are used as lubricants, such as castor oil, rape seed oil, etc? And then, there are the animal oils and greases, such as lard oil.

Aside from the fact that all oils look and feel very much alike, there is hardly any similarity between vegetable and animal oils on the one hand, and mineral oils on the other. They are utterly dissimilar in chemical structure and physical properties. Mineral oils are hydro-carbons, while animal and vegetable oils are glycerides, composed of fatty acids and glycerine. In most cases where vegetable or animal oils are used for lubrication they are simply added to a mineral oil base to give it certain properties desirable for some specific use. The total volume of vegetable and animal oils used as lubricants is very small as compared with mineral oils and the percentage is steadily decreasing. We are absolutely dependent upon mineral oils to keep the wheels of industry turning smoothly.

The difficulty with vegetable oils (animal oils possess the same properties but are used very little for lubrication and need not be considered here) is that they all have in varying degrees properties which, while very useful in other applications, render them useless for most lubricating purposes. The most troublesome property, no doubt, is the tendency to dry out or oxidize. Certain elements of all vegetable oils unite with oxygen from the air releasing fatty acids which are injurious to steel and leaving a residue or "gum" that must be cleaned away. The oil which lubricates your typewriter, for instance, should be a pure mineral oil if 'gumming' is to be avoided.

Other troublesome qualities are those of saponification and emulsification, terms very often confused. Saponification is a simple chemical reaction whereby the oils are split up and recombine with metals, generally those belonging to the alkali group. These combinations of the major portion of the oil molecule with the metal are called soaps. The soaps of commerce are generally produced by treatment of a fat or fatty oil with caustic soda or potash, but saponification may also take place in the presence of calcium, aluminum and lead.

Then, all petroleum oils may be induced to emulsify if mixed with vegetable oil, but pure mineral oils do not possess this quality. Emulsification is a purely physical action, being the mixing of oil with water to form an emulsion. The milky liquid used in machine shops to cool the tools of high speed lathes and similar machines is such an emulsion. Some vegetable oils will emulsify by simply mixing with water, while others have to be violently agitated or in some way atomized. If a pure mineral oil and distilled water be placed in a bottle, however, and the mixture agitated and then allowed to settle for a few seconds both liquids separate with a sharp surface demarcation and are clear. They cannot be made to mix.

The remarkable thing about emulsification is that while water will suspend a considerable quantity of soluble oil without an appreciable change of viscosity, if more and more oil is added, a point is suddenly reached where the solution thickens to the consistency of a solid. If this process is reversed, that is, if the water is added to the oil, this degree of solidity is reached very quickly. If a vegetable oil is used to lubricate a piece of machinery where water is liable to get into the oil a solid emulsion is formed. Advantage of this is sometimes taken in slow speed machinery. Thus it has long been the practise to add a small quantity of rape seed oil to the mineral base used in lubricating marine engines. The water from condensing steam forms a solid emulsion and this causes the oil to stick better to the guides, piston rods, blocks, etc., of the engines. But wherever high speed turbines have replaced the lumbering reciprocating engine the practise has had to be discarded in favor of a pure mineral oil.

These same qualities which make vegetable oils undesirable for lubrication render them invaluable in many industries. The largest use, of course, is in soaps and paints. Many varieties of oils and greases, from olive oil to fat offallings, are used in making soap.

The requirements for paint are more exacting. A good paint oil must be quick drying, and for this purpose linseed oil is used almost exclusively because it is the fastest drying of all oils. Attempts to use mineral oil in place of linseed oil in paints have given no encouragement to the experimenters. A paint consists essentially of a pigment or coloring matter and a vehicle for applying, and a thinner, as turpentine or a substitute made from petroleum. The solvent, when it dries, must leave behind some solid matter for holding the pigment and to form a protective coating. A mineral oil vehicle simply soaks into wood when applied and the first rain washes away the pigment.

Certain vegetable oils are regarded as essential to other industries and they are used in very large quantities. For instance, in the silk industry, olive oil soap is used to saturate the raw fiber before putting it through the various mill processes. This renders the fibers more pliable and lubricates them so that they slip easily, preventing breakage and generally facilitating all of the processes. Other cheaper oils are used for the same purpose in the wool industry.

Castor oil is an essential material in the manufacture of artificial leather and in the curing of some grades of real leather. Certain vegetable oils have become important articles of food, such as olive oil and cotton seed oil. Others, as cocoanut oil, enter in large quantities into the manufacture of other foods. Indeed, the minor uses of vegetable oils are myriad and they enter into thousands of articles of every-day use.

Castor oil represents the only apparent contradiction to what has been said. It is regarded by some engineers as essential to the lubrication of certain types of high-speed internal combustion engines, notably the rotary type of aviation motor. Some automobile racing drivers also favor the use of castor oil. There is a wide divergence of opinion here, however, and on some of the aviation fields of this country during the war mineral oils were used exclusively with satisfaction in all types of motors, even though castor oil was available.

Castor oil was first used in this way in the rotary motor for two important reasons. This motor draws its gas through the crank case and because of the affinity of mineral oils for gasoline, trouble was experienced from the "soaking up" of the gas by the oil and thinning the lubricant. It is almost impossible to mix castor oil and gasoline and for this reason no trouble is experienced from this source. The second reason is that, while castor oil is thinner at normal temperatures than the heavy oils usually required for air-cooled motors, at very high temperatures it is thicker and therefore a better lubricant. The oil in aviation motors is changed after a few hours of use so that there is not time for the undesirable features of the vegetable oil to show. Attempts to manufacture a motor oil for automobiles from castor oil, or with castor oil as a base, have generally proved unsuccessful because the oil is used for a longer time, allowing the natural reactions to set in. In addition, mineral oils are better suited to the comparative low speeds and low temperatures of automobile motors. As one engineer puts it:

"If an automobile could be kept going at sixty miles an hour and if the oil were changed at the end of every day or two, castor oil would be all right. But under ordinary driving conditions I do not believe we will ever be able to get away from the natural undesirable features."

Another reason that many motorists have been led to believe that castor oil would some day prove a panacea for their lubricating troubles, is the general air of mystery that has surrounded the subject. There are in this country only a few firms extracting castor oil and the rivalry between them is intense. The secrets of their plants are closely guarded.

But during the war when there was need of large quantities of castor oil the Government erected a plant at Gainesville, Fla., and after many disappointments and failures was able to refine a castor oil of commercial quality. The conclusions reached in this experiment have been published by the United States Department of Agriculture. The process roughly was first to clean the beans, heat them, press out the oil in a continuous process and then to treat the meal with benzol to remove the final traces of oil. Great difficulty was encountered in adapting machinery to the purpose and in developing a working technique.

The results were disappointing from the standpoint of quantity but this was largely because a crop of castor beans, the standpoint of quantity, but this was a failure. The castor bean industry is an important one in India and most of the beans used here are imported from there. The seed for the war crop planting came from India but because it was not acclimated the yield was only a fraction of what was expected. We have lapsed into our pre-war state in the matter of growing castor beans and aside from a few plants which are not uncommon as lawn ornaments, none is grown in this country.

It will thus be seen that castor oil is no exception to the general rule that vegetable oils and mineral oils each occupy a definite field of usefulness and that while they overlap to some extent there is no hope that either can take the place of the other.

There is no immediate famine in lubricating oils. Because of the large production of gasoline there is, in fact, an overproduction. This is because the same barrel of crude oil which yields the gasoline, also yields in the refining process a percentage of heavy oil. Indeed, it is now the practise to extract more gasoline from the crude by applying to the lubricating oil a "cracking" process, leaving as a final residue only a small quantity of coke.

It is not beyond conception, however, that if gasoline is displaced as a motor fuel, as indeed it must be, there will be a decided change in the economic status of lubricants, if not an actual famine.

An economical process for recovering oil from the vast shale deposits would afford relief for many years, even after the exhaustion of petroleum, but beyond that there is no substitute in sight.

Neon Lamps in Agriculture

DURING the year 1916-1917 the Horticultural Institute of Berlin-Dahlem made a number of experiments with respect to the effect of illuminating fields of tomatoes and of gherkins by neon lamps. According to *La Nature* (Paris), the surprising yields were obtained of more than 42 per cent excess over the normal for gherkins and 40 per cent for tomatoes.

The Summer Sneezer

New Light on Hay Fever, Rose Colds, and the Like

By Frank Parker Stockbridge

A HARVARD freshman committed suicide the other day at his home in Worcester rather than go back to college and be subjected to the ridicule of his fellow-students because he could not eat anything with eggs in it. From infancy, his father said, the young man's aversion to eggs had amounted to a disease, the slightest trace of egg in anything he ate made him so ill he had to leave the table. And the pity of the whole tragic incident is not only that the boy could have been cured of his idiosyncrasy but that he was only one victim of thousands who suffer from the ridicule, born of ignorance, that attributes aversions such as his to whim or obstinacy, or—in the case of girls—to "nerves." Few go to the length of suicide, like Barton Fay, but many become morbid, hypersensitive and anti-social because in childhood and adolescence they have been laughed at for saying that certain foods or the mere presence of certain substances or objects made them ill. Many others go through life as semi-invalids because they and their physicians fail to attribute their frequent attacks of illness, often with symptoms like poisoning, to some common article of food which has caused them.

Such susceptibility to poisoning by eggs as the young Harvard student exhibited is now regarded by physicians as in the same class with poisoning by plant-pollens, the most familiar manifestations of which are "hay fever" and its earlier prototype "rose colds," and with the aversions to certain animals felt by many persons who claim that contact with or the mere presence of horses, cats, dogs, chickens, sheep or cattle makes them ill. That such susceptibilities and aversions do exist has long been known. Shakespeare makes Shylock speak of persons who go mad in the presence of "the harmless necessary cat," and there are references in medical literature to "rose colds" as far back as 1565; but it is only within the last few years that the common cause of all of these phenomena has been known and a ready means of diagnosis and treatment made available to the world at large.

Reduced to the simplest terms, it is now known that certain individuals are hypersensitive to certain proteins, whether these enter the system through the stomach or through the air-passages, the symptoms are usually bronchial and often asthmatic, usually accompanied by a rise in body temperature and often by blotches or other skin eruptions. The diagnosis is simple, the skin is scratched slightly, not enough to draw blood, and an extremely dilute preparation of the suspected protein rubbed in. Sometimes, as in hay fever cases, the pollen proteins of a dozen different plants and weeds may have to be tried before a positive reaction is manifested by the appearance of a well-defined circular blotch centering at the scratch-point. And the treatment consists in administering minute but gradually increasing doses of the offending protein by the mouth or subcutaneously, until immunity is established, which in many cases comes about very promptly—a modern application of the ancient remedy, "a hair of the dog that bit you."

Literally, proteins of cat hair, dog hair, cattle hair, chicken feathers and similar animal integuments, as well as of the pollens of all sorts of trees, grains and weeds, from ash to willow, including goldenrod and rag weed, and of foodstuffs of every ordinary and some extraordinary kinds, are now available and in daily use for the detection and treatment of just the sort of susceptibility that drove poor young Fay to suicide.

Sometimes treatment even more simple than this is all that is necessary for a cure. Lumbermen in north woods used to make it a point, if they were at all susceptible to poison ivy, to hunt up a vine and eat a few of the leaves on first entering the woods for the season. A few hours of the violent illness thus induced rendered its heroic victim immune for the rest of the season!

Not long ago a man and his wife called on a New York physician who was familiar with this rough-and-ready prophylaxis of the lumber camps. Both complained of annual attacks of "hay fever" though each was affected at a different season, indicating that the trouble with each arose from a different cause. To the experienced eye of the physician the peeling of the skin on the man's face—they had just come back to town from a summer in the country—looked like the effects of poisoning by *rhus toxicodendron*, the "poison sumac" of northern woods.

"Go back to the country and eat a few poison sumac leaves," the doctor advised. "You'll be pretty sick for a day or so, but I think your condition will then clear up quickly. Do that every autumn, as soon as the leaves begin to turn."

The man took the doctor's advice and for three seasons since has been immune from the "hay fever" that formerly made the last few weeks of his stay in the country a season of misery.

The wife was sent to a diagnostic laboratory where tests were made with several vegetable proteins and the pollens of a number of June plants, weeds and grasses. She reacted to none of them but the strawberry protein. It had never occurred to her that eating strawberries was poisoning her, her symptoms were all those of one who has "taken cold," with intense coryza, sneezing and choked breathing. The next spring she abstained from strawberries and had no recurrence of the "hay fever." Then she underwent treatment with strawberry proteins with the purpose of obtaining permanent immunity, and after a year of such treatment was able to eat strawberries without experiencing any ill effects.

Instances might be multiplied indefinitely like these. The widow of a famous medical expert had all her life been unable to remain in the same room with a bird of any kind. (Her husband had died before medical research had discovered the true cause of such "phobias.") It took several months of treatment

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Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A Question of Disarmament

To the Editor of the SCIENTIFIC AMERICAN:

Apropos the relative sizes of the world's navies, built, building and sanctioned, I have been in full accord with your position that the Navy of the United States is quite powerful enough in capital ships, though it needs many more fast light cruisers and more attention to the Naval aëro service.

In view, however, of a contribution to *The Naval and Military Record* by Hector C. Bywater from which I quote a striking passage below, it may be that the late administration was not mistaken in pressing for a still larger navy. The passage reads:

"It is only in 1923 that the ratio will begin to show a marked change, but by the end of the following year—assuming that we do no building in the meantime—it will have completely altered, the American figures then being: First-line ships, 16, second-line ships, 11; against the British totals of 18 and 15. And the slight numerical balance in our favor will be negatived by the immense individual superiority of the later American vessels. At the beginning of 1925 the Japanese position will probably be as follows; First-line ships, 16; second-line ships, 8."

I do not know that Mr. Bywater's figures are correct, but, if so, it would appear that, in order to insure the peaceful progress of the United States, it will be necessary to build more capital ships in addition to light cruisers and other special craft so as to make a well balanced navy.

Naval and military disarmament would indeed be a boon to a war-tired world but, until all the great powers will approach such an agreement in an honest and open way, leaving all disputes to be settled by an impartial court of arbitration, the only safe policy is Roosevelt's "Just man armed."

Antigua, B. W. I. INTERESTED READER.

"His Hair Turned White Overnight"

To the Editor of the SCIENTIFIC AMERICAN:

In reply to the article in your correspondence column of March 26 last, captioned as above, I think the following quotation from "Forty Years in Phrenology," by the late Nelson Sizer, will explain a great many of such cases.

"In the fall of 1854, Mr. John Wallace, of Covington, Miss., aged twenty-seven called at our office for an examination. He had large cautiousness, and we observed a tuft of hair perfectly white of the size of a half-dollar on each side of his head, directly in the center of the organs of cautiousness. We stated to him our opinion that he had been pursuing a business involving a painful activity of cautiousness, like powder making, or that he had been cast away at sea, in constant fear of a violent death. At the close of the examination he stated that he was upset from a sail-boat in Lake Pontchartrain, when sixteen years of age, and held on to the bottom of the boat all night, in imminent peril of life, while his companions became exhausted and were lost. In the morning he was picked up by a vessel and carried to New Orleans, when it was discovered that his hair had turned gray on the places above described, which soon became white, and has remained so ever since. His hair being black, renders the contrast of the white spots very striking."

Likewise, O. S. Fowler, another of the prominent phrenologists of the past century, known throughout the Eastern States by his popular lectures on the subject, stated in his "Human Science," page 201, that he knew of "cases by hundreds in which fear of death by shipwreck or foul means or accident, continued for a few hours, have turned the hair gray over caution, while the hair in all other parts of the head retained its natural color."

It should be stated that the phrenological organ of Cautiousness is located in the angular gyrus, under the parietal eminence, which is the horizontal ridge quite noticeable in many heads about three inches above the tops of the ears and slightly backward from this point, on each side of the head, the size of the organ being indicated by the width of the head at this point.

The writer has studied and investigated phrenology for the past twenty-five years and knows of a case of a woman residing here whose hair fell out over the organ of Conjugality (conjugal love) on each side of her head while her husband was in a hospital under going a capital operation, and then the hair grew again, but came out white, and has been white there ever since. Conjugality is located about two inches directly back horizontally from the meatus of the ear, and is the specific faculty of love between husband and wife and sweethearts, and of fidelity, constancy, etc. Evidently the intense activity of this part of the brain resulted in the congestion, or inflammation, extending to the surface of the head, thus causing the hair to fall out. Perhaps this is the true explanation of what happens in all these reported cases of the hair turning white overnight, and the white scalp showing through the thinned covering of hair gives the appearance from a distance of the hair having turned gray or white, even before the hair has grown out again and become actually white. All chance of coincidence is nullified by the hair being white on both sides of the head at the same point, which proves that the cause was inflammation of the corresponding parts of each hemisphere of the brain. Thousands of cases in which a particular part of the brain surface has been so over active and inflamed on each side of the head that the heat is easily detectable with the fingertips, have been noted and recorded by phrenologists, and it is also proved by repeated observations that the hair turns gray first over the most active parts of the brain. I recently saw a man with a triangular tuft of white hair just below the center of the back of his head directly over the phrenological organ of Philoprogenitiveness, or love of children, and on inquiry found that he was a man remarkably fond of his children. As to cases in which the hair of the whole head turned suddenly white, I have never heard of such.

Livermore, Cal. ELMER G. STILL.

A Rare Feat

To the Editor of the SCIENTIFIC AMERICAN:

From an advertisement in a leading trade paper, back cover, issue of June 16, 1921:

"This formula approximates that of bronze, but microscopic examination shows that N - - - has a very different and denser molecular structure."

I've heard of microstructures—seen many of them in fact. But seeing molecular structures is an achievement which deserves the notice of your journal.

New York M. F. B.

Clusters and Nebulae

Some Startling Facts and Figures Concerning These Interesting Astronomical Features

By J. F. Springer

GLOBULAR star clusters constitute one of the most notable classes of celestial objects. Unlike nebulæ and stars they appear to be limited in number. Space is apparently, not at all crowded with them. The total number so far discovered is around 86. As only about six or seven per cent of these are clusters added in the course of some 80 years, despite the great number of observations and the high powers of the instruments, it begins to appear as if the reason why globular clusters are being found only at the rate of about seven a century is because we are approaching the end of the list.

Perhaps the most remarkable of all the globular clusters is the Great Cluster in Hercules, the celebrated Messier 13. To the naked eye sharp enough to discern this object, it appears as a faint, hazy star. It is some 2 deg. south of Eta Herculis. When the cluster is brought fairly into the field of a telescope of considerable power the minute patch of haze is resolved in a host of minute points. The globular form is not especially apparent, but in the region of dense population, three dark spokes or radial lanes are seen. These roughly divide the starry region into three approximately equal sectors. But a more recent view of the great cluster, obtained photographically by Professor Ritchie by an 11 hour exposure of a plate of medium rapidity, fails to show the dark lanes. This view brings out more clearly the globular appearance. On this plate, H. Shapley informs us, are recorded more than 30,000 star images brighter than the 21st magnitude. The negative was produced by the use of the big 60-inch reflecting telescope of the Mount Wilson Observatory. It is no great wonder that some have regarded such aggregations of stars as other universes. In general, they are more or less isolated in space, the surrounding regions being very sparsely populated.

The Great Cluster in Hercules is so far away that it is useless to attempt to determine its parallax—the angle subtended at the object by a radius of the earth's orbit—by ordinary methods. However, by studies of "the frequencies of the colors and the apparent magnitudes," the conclusion has been reached that the parallax lies somewhere between 0".00001 and 0".00010. A further study—one involving Cepheid variables, red giant stars, stars of spectral type B, the apparent diameters of clusters—has resulted in the choice between the foregoing limits, but fairly close to the maximum, that is, 0".00009. This means that the Great Cluster is some 36,000 light years away. This means in turn, since one light year = $5,875 \times 10^9$ the distance is 211,500,000,000,000,000 miles. The Ritchie photograph shows this cluster not as it now is, but as it was 36,000 years ago when the light now arriving started on its way. In fact, this is not a sufficient correction as the cluster negative, for example, has been on the way 160 light years. Some of the light arriving to make this negative bad, for example, has been o uthe way 160 years longer than other light. It is something like a newspaper in the pre-telegraphic days. Some of the events narrated had just transpired, because the *locale* was near-by; other events had happened weeks or months before, the news having just reached the journal because of the distance it had to come.

This brings us to a more general fact. We never see the heavens as they really are or even were, but see an unreal image made up of infinitesimal patches having dates of an enormous range. The enormous size of this giant cluster may perhaps be better grasped if instead of saying that it is 160 light years across, we say, with Shapley, that a star at the distance of a cluster-diameter from us would have to be 100 times as bright as our sun to become visible to the naked eye. And yet this diametral length is a distance almost out of all comparison with the distance of the cluster from us. If we measure off a line 14 inches lon, and then place at one extremity a steel ball 1/16 inch in diameter we will have a means of comparing the cluster with its distance from us. [Author's note. I have taken as the cluster proper, the central condensation. Shapley estimates the aggregation as having a diameter more than twice as great.]

What does the sparseness of stars in the space around a cluster mean? Is the cluster the condensation of stellar bodies which originally occupied a more gigantic region? Or, are the globular clusters young aggregations, aggregations which are in an early stage of expansion? Or is there some other and distinct explanation? No man can give answers that are reasonably certain to be true at best, it is merely guesswork.

But let us look within the cluster a moment. The stars seem, especially those toward the interior, to be very thickly congregated. This appears to be the actual condition of affairs. The nearest star to our solar system is usually taken to be Alpha Centauri. Its distance is 3¼ light years. If our sun be taken as the center of a sphere having this radius, there would be but one star within that sphere and this star would scarcely be within. But, if one turns to the Great Cluster in Hercules, and attends to a *circle* of the same radius, this circle being placed at the center of the cluster image, he will, it is said, in effect, find thousands of stars within it. Of course, there are stellar points here belonging to the full diameter. That is, we have, neglecting stars behind one another, thousands of stars in a cylinder, which corresponds to the circle and is 160 light years deep. There could be put some 24½ spheres in this cylinder, and they would fill two-thirds of the space. Roughly, then, the amount of space whose stellar inhabitants are sending their images to the center circle of the Ritchie photograph are those of 36¾ times the space occupied by the sphere. So, then, we may divide the thousands by 36¾ and still obtain a goodly number. In such a sphere we have two stars—our sun and Alpha Centauri. Apparently, the center of the cluster is very many times as thickly populated as our region of the universe.

Quite recent work on globular clusters is understood to tend in the direction of showing that the form is not truly spherical but slightly elongated. This, if completely confirmed, will be a big fact. The Great Cluster in Hercules is one of the most flattened of the oblate spheroids. This may not be recognizable, perhaps from mere observation. But counts of the stars in the telescopic photographic projection of the cluster show that in the direction of one particular diameter there are about 30 per cent more stars than in the direction of the diameter perpendicular to it. There is some reason then to view this cluster as somewhat elongated in the direction defined by the first diameter. Naturally the question arises: Is this flattening of the spherical form due to rotation? This cluster is thought to contain not less than 100,000 stars. The total mass must be enormous. As a whole the cluster is moving at a rate not slower than 125 miles per second. This 125 miles per second is the velocity toward us and the general galactic plane.

Research coupled with the use of assumptions seemingly probable, has resulted in the completion of a list of the distances of 86 celestial objects, nearly all of which objects are definitely known to be globular clusters. As the precise locations in the sky are known it is possible, by combining all these items, to map them in space of three dimensions. If, now, first of all, we consider the apparent distribution—that is, without reference to their distances from us—these clusters will be found to be located mostly in the Southern Hemisphere of the skies, only about a dozen being in the Northern Hemisphere. But most of the dozen are relatively near us. In the Southern Hemisphere the globular clusters tend to positions near the Milky Way. Thus, quite a number are to be found in the constellations Scorpio, Sagittarius, Centaurus. But while these clusters seek nearness to the Galaxy, they are almost entirely absent from a belt 10 degrees wide bisected by the plane of the galactic circle. This state of affairs is in wonderful contrast to the apparent distribution of the more numerous class of *open clusters*. These clusters tend to congregate close to the galactic circle, and to become very much less numerous at short distances on both sides. We have in the foregoing a large fact with respect to both classes of clusters. Their distributions, as viewed from the earth without reference to distance from us, apparently have some close relation to the position of the Milky Way. It is such facts as these that make it difficult to believe that globular and open clusters are universes really isolated from our stellar system—that which is largely defined by the Galaxy.

Consider for a moment the broad situation. The concentration of open clusters lies in a narrow belt divided along the middle by the gigantic circle. The concentrations of the globular clusters lie in narrow belts just outside of the belt of open clusters. There are practically no globular clusters in the strip where the open ones lie. Part of the foregoing could be pretty well explained if we conceive the Milky Way to be exteriorly surrounded by a ring of dark matter—cold gas, for example. The absence of globular clusters would then mean simply that there was none inside the circle of the Milky Way and that those outside were hidden from view by the occulting matter. The presence of open clusters in precisely the belt where globular clusters are absent would mean that they are inside the Galaxy and comparatively near. If we understand that the Milky Way defines a region destructive of the globular condition, then the absence of globular clusters and the presence of open ones inside the Great Ring is explained. The open ones are the residues of globular clusters. But we have still on our hands the great fact that both descriptions of clusters are very sparsely distributed in high galactic latitudes. Why is this? The 86 globular clusters are evenly divided between the two sides of the galactic plane. Something similar may be said in respect of the open ones.

In a broad way, the nebulæ supplement the clusters. Where clusters are lacking, there are plenty of nebulæ, where nebulæ are lacking, there are plenty of clusters. But the numbers of the two great classes of objects are quite different. There are many nebulæ and comparatively few clusters. Still, the supplemental idea is to be held. We might understand the matter better if we could conceive that in some way a group of nebulæ corresponds to a single cluster. Thus, we might think of many nebulæ combining in some way to form a cluster, or we might conceive of a cluster producing many nebulæ. If either conception can be seriously entertained, it helps us to simplify our ideas of the universe as a whole.

The distances of the globular clusters are enormous. The one that is supposed to be nearest—Omega Centauri—is some 20,000 light years distant. A certain cluster in the constellation Delphinus is perhaps the most distant one of these objects. It is thought to be 220,000 light years away. This is getting into the same class of distances as the length of the diameter of the Galaxy. A couple dozen of the globular clusters are judged to be at distances greater than 100,000 light years. If the group of 86 clusters be contemplated as a gigantic whole, it is seen to form an ellipsoidal system with the plane of the Milky Way dividing the ellipsoid symmetrically with 43 clusters on each side. The long diameters of the ellipsoid are apparently not less than 300,000 light years long. That is, these dimensions are substantially identical with the long diameter of the Milky Way itself. The short diameter of the globular-cluster system is reckoned at, say, 150,000 light years, but the length is by no means definite. It has been proposed that the system of globular clusters be viewed, tentatively, as coextensive with the Galaxy and as having the same equatorial planes and possibly as having the same center. In short, in the eyes of some, the globular system is part of a great organization and the plane of the Milky Way is a basic feature of this organization.

The globular clusters are all, apparently, without any absolutely known exception, distant from the galactic plane. The nearest one of the 86 is 22 Messier (in Sagittarius). This cluster is not so well defined as a globular system as others. It is, in fact, one of the most open of the whole group. But even this, relatively open, cluster is some 4,000 light years distant from the plane of the Milky Way.

The practically complete absence of globular clusters from a belt along both sides of the galactic equator is a notable fact. Are they really absent from space in this region, or are they simply hidden from our view because of the intermediate presence of dark matter? This is a question that cannot with any certainty be answered at the present moment. However, the region is a wide one, the total width of the zone of absence having been estimated as some 12,000 light years broad. In this region, some open clusters and blue stars which are thought to be as far away as some of the globular clusters, have been discerned. Just what part obscuration plays is at the moment indeterminable.

The nebulæ, particularly spiral nebulæ, avoid the region of the Milky Way. Nebulæ, apparently small and white in color, exist in large numbers near the north pole of the Galaxy. There are some, but they are distinctly less numerous, near the south pole. It has been ascertained that nearly all these white nebulæ are spirals. Of the spiral nebulæ as a class, it may be said

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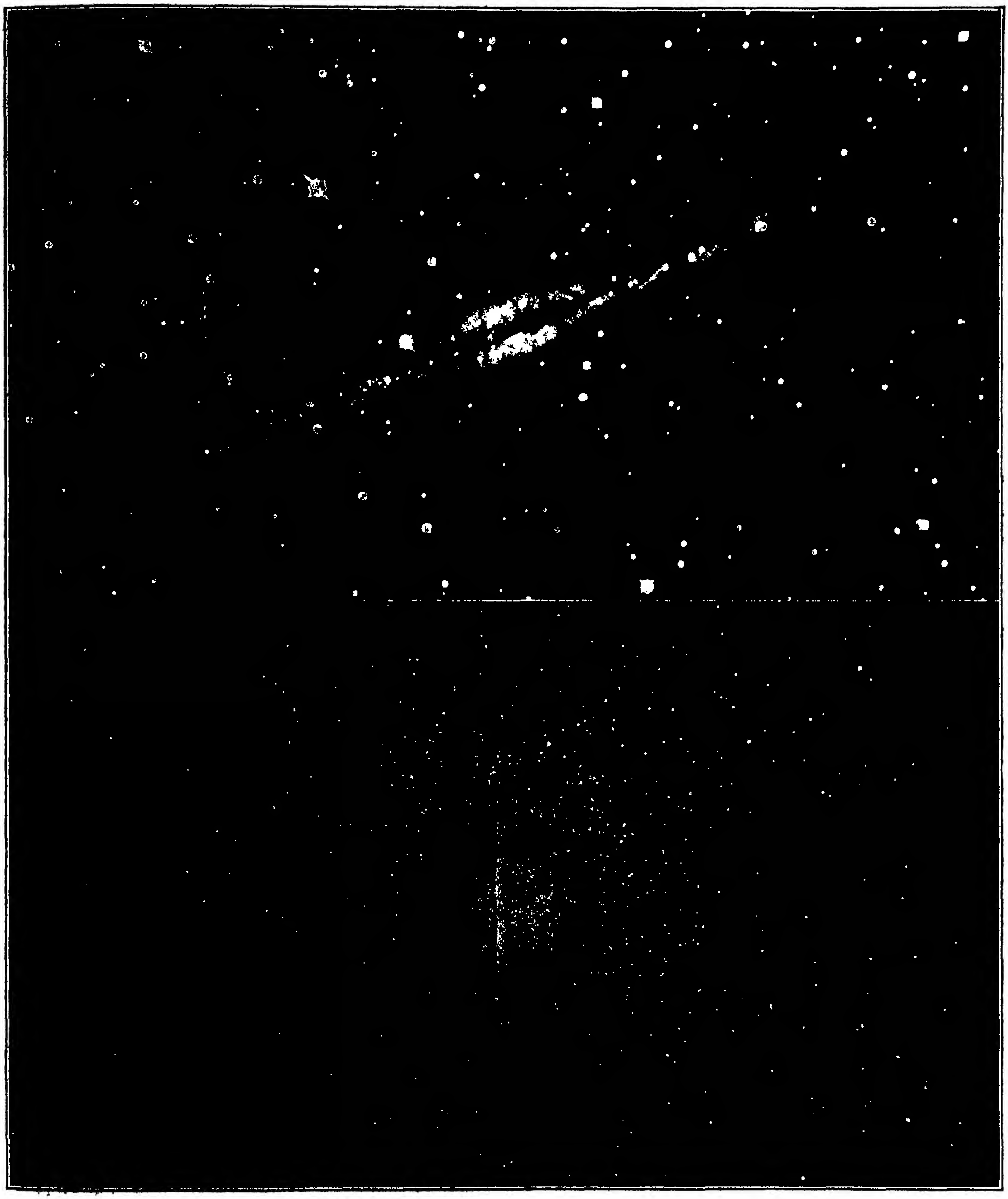


Upper View: This photograph is presumably the "spiral nebula on edge." The quotation is taken from the Mt. Wilson catalogue statement
Lower View: The great globular cluster, one of the greatest objects in the heavens

Man-Made Precious Stones

Efforts of the Past and Present To Produce Synthetic Rubies, Sapphires, and Even Diamonds

By C. M. Lewis

A display of the different shapes in which rubies are cut for use in jewelry

FOR almost a century chemists have been trying to manufacture precious stones, finally succeeding to such a marked degree that only the experienced eye of the lapidist can distinguish between the natural gems which come from mines and the scientific stone, as it is sometimes called, which is produced in the laboratory. It is interesting to follow the series of experiments by which this process of manufacturing precious stones has been perfected.

With the exception of the diamond, which is composed of pure carbon, most precious stones are composed of aluminum, whose uncrystallised hydrate silicates or clays are quite commonplace substances. Crystallised aluminum or corundum, on the other hand, occurs much less frequently. Sometimes it is white or colorless, and sometimes different metallic oxides give it color and brilliancy. Our precious stones, the ruby, the sapphire, the emerald and the topaz, are natural specimens of corundum, red, blue, green and yellow.

The first attempt of the chemist to reproduce these precious stones was made by liquefying aluminum, adding a colorant and then causing its crystallisation by a cooling process. As early as 1837 Gaudin, and later in 1850 Sénarmont, worked out the composition of corundum. At about the same time Ebelmen, director of the *Manufacture Nationale* at Sèvres, made microscopic crystals of ruby by heating a crucible containing aluminum, boric acid and chromium in a porcelain oven. A little later Henri Sainte-Claire Deville and Caron, by utilising the reaction of anhydrous boric acid vapors on the fluoride of aluminum, succeeded in making rubies in the form of thin crystal-like scales. Again in 1865 Delray and Hautefeuille undertook the problem. But it was M. Fremy, with his two assistants Feil and Verneuil, who at last succeeded in working out a satisfactory solution. This was accomplished by a most remarkable series of experiments conducted from 1877 to 1890.

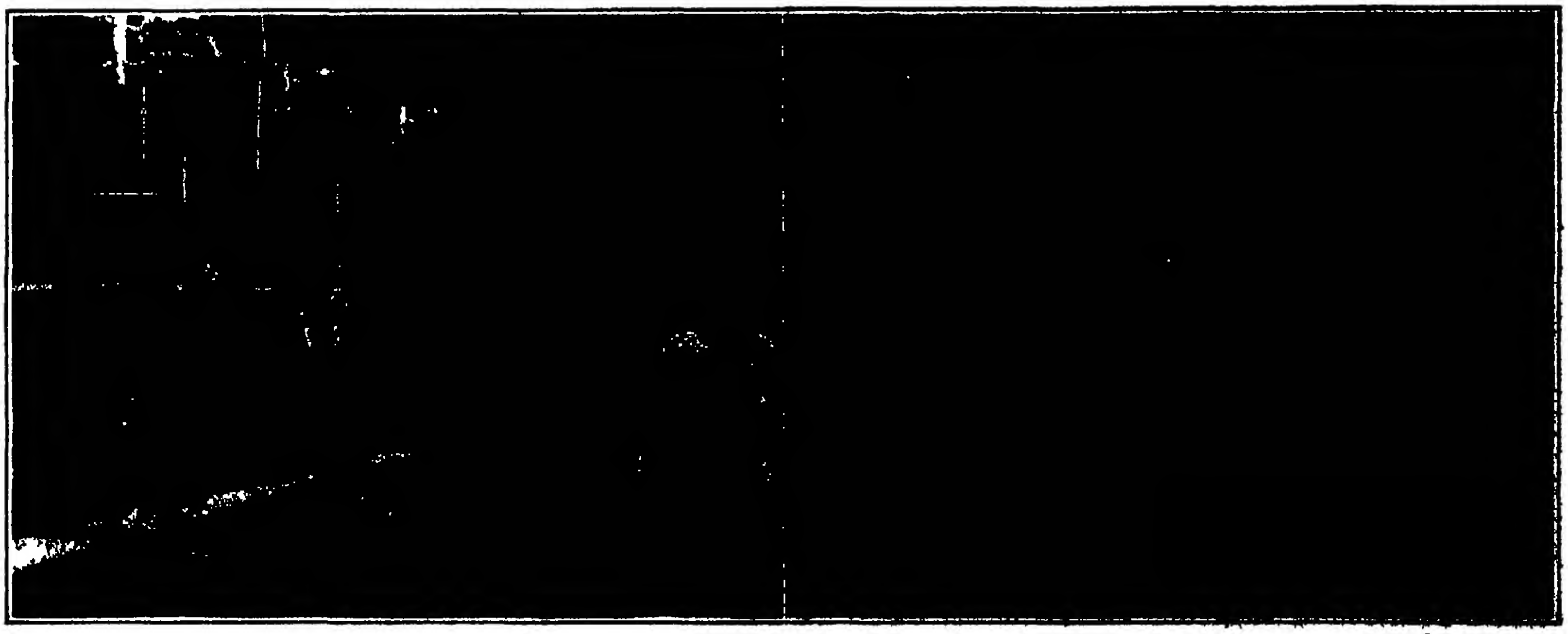
The first method used by Fremy and Feil was to form an aluminate of lead. This aluminate was then decomposed to free the aluminum and produce its crystallisation. Rubies were produced by adding bichromate of potassium to color the crystals red, or a little cobalt oxide was used as a colorant to make sapphires. But the crystals were still too scale-like and fragile to be used by jewelers. In a second series of experiments Fremy and his second collaborator, M. Verneuil, brought about the crystallisation of aluminum at high temperature by utilising the action of the fluoride of barium in the presence of potassium. Due to an accident a little air was allowed to circulate in the crucible, and as a result beautiful rhomboid crystals were formed—rubies as clear and brilliant as those found in mines and solid enough to be cut. But the crystals were still too small to be used as jewels.

It was about this time, in 1882, that Diener Wyse displayed in Switzerland rubies of such brilliancy as to create a sensation among lapidists. It is believed that he made them by combining bits of natural ruby by fusion. Although they were fragile he sold them for as much as 100 to 150 francs a carat. According to Friedal these crystals had all the properties of the natural ruby except for the appearance of gaseous bubbles and a little lighter density. When they were examined in the spectroscope they showed the same absorption bands as appear in the natural ruby. A little later the chemist Maich succeeded in making ruby in large blocks, but his product did not possess the clear transparency of the natural ruby.

About 1895 another French scientist, Michaud, put on the market a scientific ruby and commercialised the process of its manufacture. First, a small ruby was placed in a platinum crucible and stood up in the center of a revolving tray, where the flame from an oxidizing blowpipe brought it to a temperature of 1,800 degrees. Then small bits of ruby were added. These particles liquefied, united and recrystallized in a mass which could be cut. This work required, of course, great skill, since there was great danger of the crystals being splintered in the cooling. Rubies made by this process cost as much as 12 francs a carat. But they were so like the "real thing" that when they were sent to German, American and Indian markets, they were sold back to Parisian jewelers for natural stones!

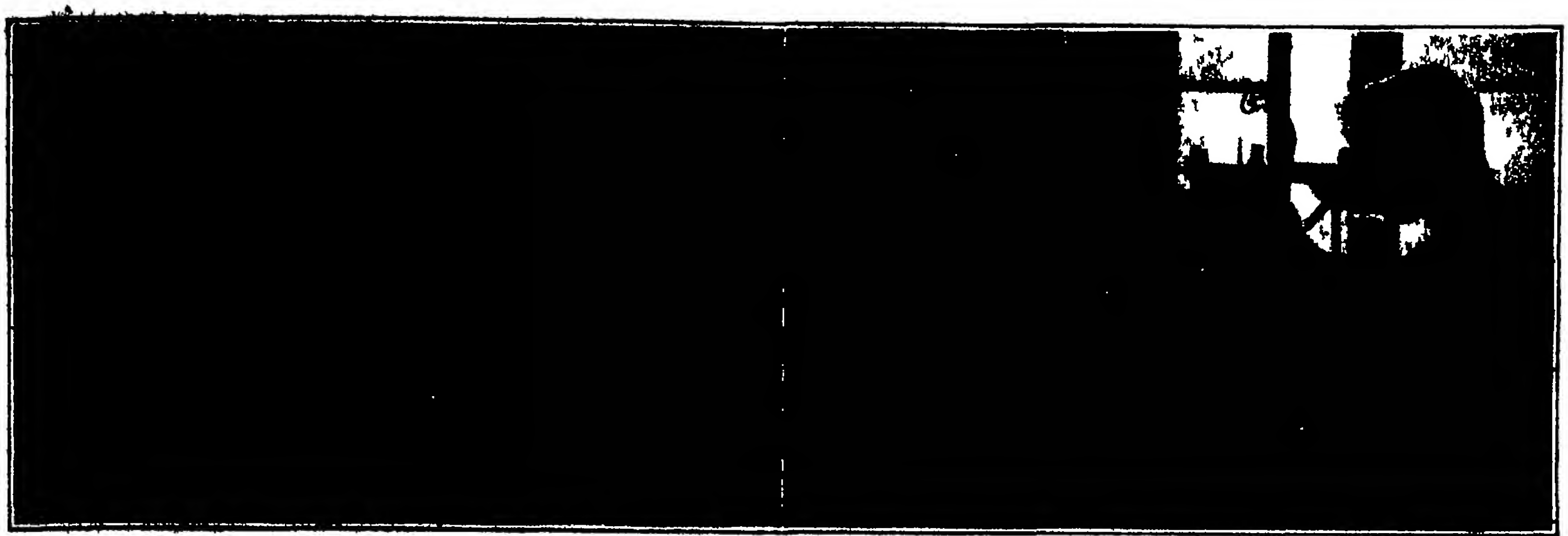
M. Verneuil went on with his experiments in collaboration with his pupil Paul Maquier.

In Verneuil's process, first of all alum is calcinated and usually salt of chromium is added, which, according to its degree of oxidation, will color the resulting crystalline sediment red or blue. This mixture is sifted through a fine sieve. Pulverization is effected automatically by means of a very simple device. Flat brushes are fastened to the handles of horizontal levers, a little motor turns them inside the sieve, and the sediment is thus forced through the holes. The powder enters a little reservoir fitted to the upper part of a gas jet. A mallet operated by an electro-magnet taps at regular intervals on the cover of the reservoir, causing the aluminum, now pulverized, to pass through a grating and to fall in the tube to a pipe which opens near the lower hole of the reservoir and leads from the oxygen compressed in steel cylinders. The workman opens the spouts of these reservoirs slightly to obtain a temperature of 1 800 to 2 000 degrees. In each of the gas jets the current of gas draws the powdered aluminum across the flame and it is transformed into tiny incandescent drops, some of which fall into a platinum cup surrounded with a fire-proof clay covering to prevent the loss of heat. This insulating covering is in two parts which can be brought together, with an opening left in the center where the experimenter can watch the work. As the aluminum cools it crystallizes and the block of ruby becomes larger. Each of the gas jets makes on an average ten carats an hour,



Left: A battery of furnaces for the production of synthetic sapphires as employed in a French artificial gem factory. *Right:* A battery of furnaces employed in the production of artificial rubies

Some of the apparatus employed in the making of synthetic sapphires and rubies



Left: Electric arc furnace employed by Moissan in the production of his synthetic diamonds, shown dismantled, with the cover and the crucible resting on the table. *Right:* Polishing the synthetic gem by holding it against a revolving bronze disk covered with wet rotten stone

Electric furnaces employed in the production of artificial diamonds and the polishing of the synthetic stones

and the blocks of ruby can be made as large as 80 carats. When the blocks have reached the desired size the flame is extinguished quickly. This sudden cooling gives the stone a temper and facilitates the breaking of the mass.

When the fusion has been accomplished without accident, pieces of the ruby are easily broken off with pliers, and, because of the temper the break is clean and sharp. Otherwise the stone splinters and disfiguring cracks occur. The particles thus broken off must then be cut into various shapes and polished. These two operations are very similar. The ruby is set in a kind of cement on the end of a stick. For cutting, the workman presses the stone against a copper grind stone covered with coarse powder. After it has been cut to the desired shape and size to give it brilliancy and transparency it is polished by rubbing it against a bronze grind stone powdered with wet rotten stone. One of our illustrations shows the most popular forms of cut rubies.

Such was the state of the ruby industry when in 1908, M. Louis Paris, a student at the Pasteur Institute, announced that he had manufactured a sapphire. Up until this time chemists had not succeeded in adding to aluminum any substance other than chromium, since aluminum threw off foreign substances in the process of crystallization. M. Paris, however, added lime and magnesia to liquefied aluminum to prevent its crystallization and then added cobalt as a colorant. The aluminum, the colorant and the foreign substance, finely pulverized, were put in an oven and brought to a temperature of 1,700 degrees. After baking the powder was placed in reservoirs, as may be seen in our illustration, above heaters which operate on the same principle as those used in the manufacture of rubies; they differ from latter only in certain details of construction. In particular, a sheet-iron box (instead of the fire-proof clay insulator) insulates each part of the process, and has in it a red pane of glass through which the work may be watched.

The artificial sapphire, however, is not nearly so good an imitation of the natural stone as is the manufactured ruby. It is only a chemical composition which has a density and durability very little like that of the natural sapphire. The scientific ruby, on the other hand, is almost identical to the mined ruby. The layers of crystallization are as clear in the man made ruby as in the natural stone, air or gas bubbles are visible when examined under the microscope in both the real and the imitation stone. In fact the eminent geologist Lacroix thinks it is impossible to distinguish between them with certainty.

So much for the ruby and the sapphire. But it is the diamond which has baffled the scientist in his experiments. By innumerable processes has he tried to manufacture that most valuable and elusive of stones.

The chemist Moissan has succeded in reproducing it, however by uniting high temperature and strong pres-

(*Continued on page 56*)

A Water-Filled Hose That Controls Shallow Rivers

THE practicability of damming shallow rivers by means of a large hose filled with water has been demonstrated by Norwegian engineers. It has also been shown that this invention is of great practical value in molding concrete under water, making it possible in some cases to eliminate cofferdams in building bridge foundations, etc. This method can be used for raising the water level in irrigation canals, for protecting levees and river banks, for lumber drives, and for military purposes.

To give an illustration of how this system works. It was decided to bank up and shut off a branch of the Randsfjord River in Norway. The river bed at the point selected consists of small stones on underlying ground of pebbles, gravel and clay. The bed was therefore leaky and could be readily washed away. The hose used was of cotton canvas. It was 150 feet long and 40 inches in diameter. It was anchored by cables to stakes set in the bed of the stream and the ends were anchored to the shores. One end of the hose was closed. A standard one-man diaphragm pump mounted on a military pontoon was used to fill the hose, about 20 minutes being required to fill the hose completely. After the big hose had been used 48 hours as a dam it showed that it served nearly as well as at the beginning.

This method has proved of value in raising the water level in sluggish streams where logs are left on the banks and shallow places. By the gathering of large masses of water above and their sudden release artificial tidal waves are caused, releasing the logs.

Foundation works and fords are rendered possible for short periods by repeated banking up of the water.

It has been shown that it is possible to apply the same principle to the casting of concrete and at the same time to avoid the washing out of the materials and the use of cofferdams. A strong and flexible canvas covering is given the desired form, is lowered empty to position and anchored. The liquid mortar is then poured in under pressure.

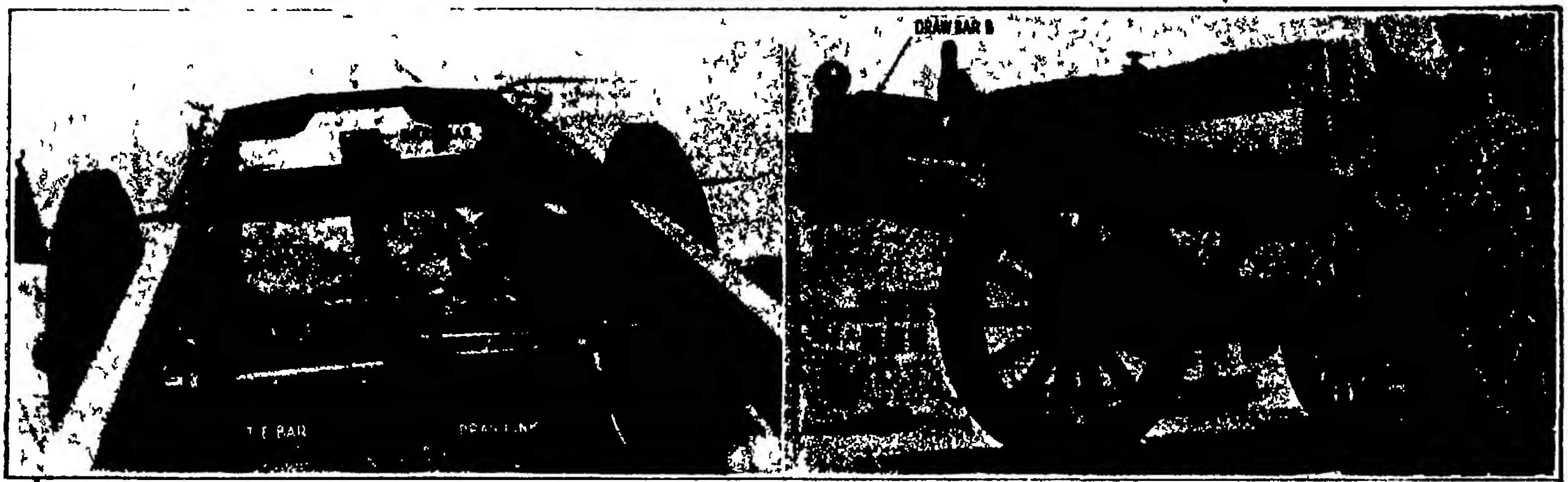
Laying out the water hose across a shallow river, preparatory to filling the hose with water so that it may dam up the river

The water hose dam filled and serving to hold back the river water. Note the relative levels of the water on either side of the hose dam

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W PAGÉ, M S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



Left Showing steering mechanism of four wheel trailer and method of attachment to axle. *Right* How the drawbar and steering bar are attached together for the forward movement of trailer, so it will track with truck towing it

New Four-Wheel Trailer

ONE of the greatest objections against the use of four wheel trailers has been the fact that they did not, under all conditions, properly track with the trucks. A prominent trailer manufacturer claims to have solved this problem by a steering arrangement which, by the long leverage of the steering arm, guarantees complete control of the steering mechanism, thereby eliminating any possibility of any deviation of the trailer from the path of the truck A further serious objection against old type four wheel trailers was that they are hard to operate in places difficult of access and hard to steer when backing up

By a radical departure from methods employed in the past this maker is providing for the attachment of the steering arrangement to the drawbar when the trailer moves forward and with the axle, in a locked central position, when the trailer is to be backed up This new method eliminates the possibility of knifing the drawbar when the trailer gets into a cramped position when backing up and the damage usually caused in such an emergency

Under the new method when backing up, the front wheels of the trailer are locked in a permanent position parallel to the frame or at right angles to the axle, while the drawbar is permitted to swing to either side without possibility of damage as the drawbar is now disconnected from the steering arrangement and receives nothing but the rearward push of the truck for the purpose of moving the trailer backward During the backward movement, the guiding of the trailer is effected by an auxiliary steering bar to be applied to the rear end of the trailer In extreme cases, for instance, when the problem exists of moving the trailer around a post, both sets of wheels can be arranged at any angle, which will permit the movement of the trailer around any obstacle

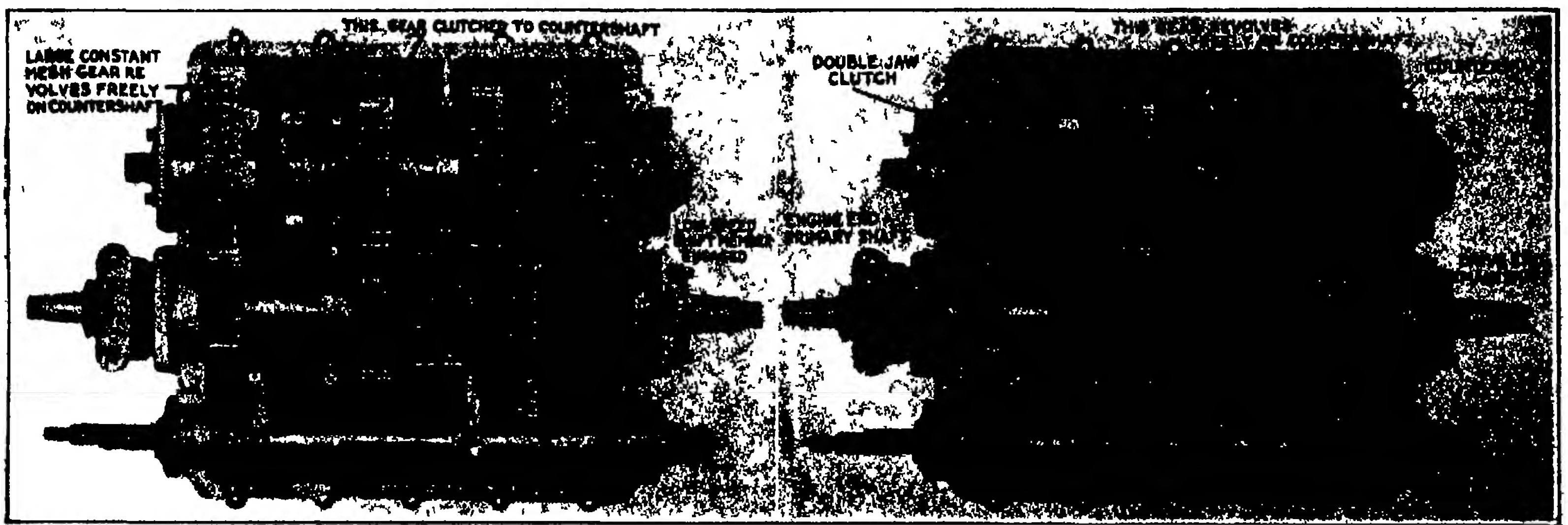
By providing the possibility of attaching or detaching the steering arrangement at will or as necessity demands to or from either the drawbar or the axle the maker has provided the flexibility of operation which is so desirable The method of detaching from and attaching to the drawbar or axle, as the case may be is extremely simple and fool proof, the principle of universal ball and socket joints being maintained even in this detail of construction Construction of the trailer itself does not vary in the construction of four wheel trailers in the past. In designing this new improvement the maker has kept in mind the necessity or desirability of changing old models which are now in operation, into the new models by furnishing the necessary parts at reasonable prices which can be built into the old models by any mechanic familiar with truck or wagon work

Compound Gearset Design

THE usual form of three-speed selective gearset used on the majority of passenger automobiles is not satisfactory on heavy duty motor vehicles intended for commercial purposes and there are conditions met with in such service that make even the four speed gear box that has been provided on a number of trucks inadequate at times. The accompanying illustrations show a transmission used on a new type of truck which provides five forward speeds and two reverse ratios without having any more parts than the ordinary four speed transmission It is claimed that with a transmission of this kind under favorable conditions 36 per cent more speed is obtainable without augmenting the engine crankshaft revolutions or consuming more fuel It is also stated that on the extreme low gear ratio 91 per cent more power can be secured without running the engine at excessive speeds.

The manner in which the added speed ratios are obtained is clearly outlined It will be observed that a small gear on the primary engine-driven shaft meshes with a large constant mesh gear on the countershaft Instead of having only one set of constant mesh gears, as is the case in the ordinary three- or four-speed gearset the design illustrated has really two pairs of constant mesh gears, either one of which may be clutched to the countershaft by a double jaw clutch member This slides on keys so that it must drive the countershaft regardless of which of the two constant mesh gear members it is clutched to The higher speeds are obtained when the jaw clutch engages the constant mesh gear on the counterahaft that is of practically the same size as that on the main shaft.

(*Continued on page 56*)



Left: Countershaft in high gear position low gear shift member engaged with pinion on countershaft. Shifting the double jaw clutch member will provide a much lower gear ratio to cope with unusual operating conditions. *Right:* Countershaft low gear engaged, but countershaft ineffective. High speed shift member in direct drive position, power transmission direct from engine to drive ends of shafts

New design of gear box which provides for five forward speeds and two reverse

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices Tools, Farm Implements, Etc

Pertaining to Aeronautics

AIRPLANE.—J E. PEARSON, Mimosa, N C. The purpose of this invention is to provide an airplane having greater plane surface and greater carrying capacity without increasing the weight of the machine The airplane comprises a fuselage including an inner body of rectangular formation and an outer body of cylindrical formation, a vertical plane arranged along the longitudinal axis of the fuselage, a horizontal plane arranged along the longitudinal axis of the fuselage and disposed at right angles to the vertical plane

Pertaining to Apparel

NECKTIE.—M. F WALZ, 610 Nebraska St., Huron S. Dak An object of this invention is to provide a necktie which will not become wrinkled in service A further object is to provide a device of this type that can be slidably moved between the wings of a collar can be readily adjusted, presents a neat appearance, and in which a stick pin may be thrust therethrough to prevent accidental disengagement.

BRASSIERE.—I PANES, 2107 Mapes Ave., Bronx, N Y The invention contemplates the provision of brassieres which may be readily caused to properly fit women of different sizes. An object is to provide a garment which may be easily put on and taken off A further object is to provide a brassiere which is formed of two independent parts connected together at the upper edge with each part provided with the tie strings for independently tying the sections in place.

Electrical Devices

MAGNETO.—E. A NEW, address Wm W Nicoll, 11 Broadway, New York, N Y The invention relates more particularly to hand operated magnetos designed to discharge a uniform current at each operation and which is particularly adapted for use in blasting operations. A further object is to provide a magneto which is operated by a spring and winding means to store energy therein, and which means are disconnected when the spring has been given a predetermined movement.

Of General Interest

CLOTHES HANGER—R G TYLER, 15 Billingham Ave, West Everett, Mass. An object of the invention is to provide a clothes hanger which may be readily installed in a closet or cupboard and which will be adjustable as to length. A further object is to provide means for attaching the hanger to a support, which means may be folded so as to take up very little space when the hanger is not in use

LAWN SWING—G H BUGENHAGEN, Weinrebe Bldg, Minot, N D An object of the invention is to provide a device in which the carriage of the swing may obtain any desired height in its oscillatory movement without causing the occupants to be brought into contact with the supporting frame A further object is to provide a swing in which children or other occupants may easily enter and leave the seats, and in which all danger of pinching the hands between the working parts is eliminated.

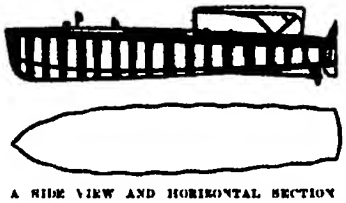
FOLDING CONVERTIBLE GO-CART, HIGH CHAIR AND BABY-JUMPER.—O H. MEYERS, 530 W 46th St., New York, N Y This invention relates to combination devices, an object being to provide an apparatus which by different positioning of the parts perform the functions for which it is intended. A further object is to provide mechanism which can be easily and quickly manipulated to change the position of arrangement to perform the functions of a baby coach, a high chair and a baby jumper

COLLAPSIBLE CRATE OR PACKING CASE—N J MCLEOD and C. F RAINSFORD, Eagle Hotel, Hindley St., Adelaide, South Australia, Australia. This crate has been especially designed for packing, shipping and the transportation of exhibition poultry, or may be used for other purposes, its special feature being that when empty it can be collapsed or folded down into small space for transit or storage, thereby reducing space; consequent cost, and the liability of breakage, when erected the parts interlock and hold one another firm.

SHOESTRING TIP.—A. C. LADD, Creede, Cal. An object of this invention is to provide a means for retaining the shoestring in the eyelet of a shoe. A further object is to provide a hooked tip which may be used with either round or flat shoe laces, and which catches in the upper eyelets of the shoe and enables the rest of the string to be loosened without pulling the ends out of the upper eyelets.

SANITARY TUB AND SINK TRAP—H J MCGUCKIN, 770 9th Ave, New York N Y This invention has for its object to provide a trap which will properly trap one or more fixtures and trap both articles against the passage of gas from the sewer A more specific object is the provision of a trap to which two or more drain pipes may be connected, the connection for most of the pipes being beneath the level of the water in the trap

BOAT HULL.—G GRIST 1328 Boston Road New York N Y The object is to prevent a boat-hull structure in which it is possible with



A SIDE VIEW AND HORIZONTAL SECTION

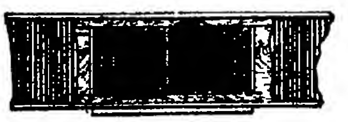
the same horsepower to obtain an increased speed The boat hull comprises side portions having a plurality of integral vertically extending wavelike corrugations throughout its length the corrugations having an amplitude relatively small compared to the wave length

PLASTER BOARD—J J DOOLEY and T H A HOWLEY, 213 Beach 118th St, Rockaway Park, L I N Y The invention has for its object to provide a plaster board arranged to lock or key the plaster in place Another object is to reinforce the plaster board and at the same time provide a simple means for nailing it to the studding joists or other support without danger of the nail head pulling through the board in case the latter becomes damp or soft

FISHHOOK—A F THORSTEIN, c/o Lillian B Thorstein 1121 Flatbush Ave Brooklyn N Y An object of the invention is to so construct a fishhook that no danger of the same tearing the fish's mouth exists no matter how great the pull A further object is to provide a construction which shall be extremely simple, its parts being such that it may be manufactured at small expense at the same time be strong enough to reduce the danger of breakage to a minimum

DISPENSING CABINET—W E. CASSELL, address Lardner & Cannon 15 Harbison Block Fort Scott, Kan Among the objects of the invention is to provide a dispensing cabinet which will be mainly transparent so as to attractively display the goods and which can be operated to dispense the lowermost article in any of the compartments, one at a time provision is made by which the device can be readily taken apart for cleaning and easily assembled

CONCENTRATOR.—J W POLLOCK Soldiers Home, Sawtelle Cal This invention relates to a construction of riffles and amalgamating trays for use in placer mining The trays may



A PLAN VIEW OF THE DEVICE

be readily removed to collect the gold by sliding them transversely of the sluice and other trays slipped into their places. By means of this construction a very high percentage of flour gold may be saved as well as the black sand.

NEGOTIABLE PAPER.—C D GRATON, 216 Roseville Ave., Newark, N J The invention especially relates to checks, drafts, money orders, and the like. Among the objects is to provide a check which is to safeguard the payor against fraudulent methods being carried out to raise or increase the amount originally provided for, and to provide a check which has a wider range than the ordinary travelers' check in that the check may be made travelers check in that the check may be made out for the exact amount of the purchase of goods.

WINDOW—A MACKINNON, Tuckahoe N Y The general object of the invention is to provide a window having sliding sashes pivotally connected with suspending chains or cords to permit of the window being turned about the pivots as an axis for convenient cleaning or to provide ventilation to a greater or less degree a novel form of stop beads and parting strips factoring in the turning of the sash

SAFETY MATCH TRAY—A A TUBBS Hotel Charlton 68 Plummer Ave Hammond Ind The invention is primarily designed to be used for advertising. An object is to provide a holder which may be placed in hotels, restaurants and the like so to afford easy access to the matches and the striking surface while at the same time prevent the liability of the box being carried away

ATTACHMENT FOR EXTENSION TABLES—J O LARSON c/o Bierman Furniture Co., Northfield, Minn The object is to provide an attachment by means of which extension leaves may be added and firmly locked to the table and to each other at one side to prevent any displacement with respect to the top and each other and wherein the leaves are easily detached when desired.

DAM OR CHECK—C I SYKES and S MITCHELL, Box 531 Ault Colo This invention has for its object to provide a device capable of being transported from place to place, and being secured in place in a ditch or drain at any desired point for forming a check or closure to stop the flow of water and wherein the said dam or check is provided with means for permitting a restricted flow which may be regulated

PROCESS OF REDUCING IRON FROM THE ORE.—J T JONES 1104 Mississippi Ave Dormont, Pa. An object of the invention is to provide a process for reducing iron from the ore without the use of lime, and for recovering the iron in a form which may be more readily handled or shipped A further object is to provide a process by means of which not only is a smaller amount of fuel needed but a portion of the fuel is recovered in the form of coke of good burning quality

PROCESS OF PRODUCING FERROSILICON—J T JONES 1104 Mississippi Ave Dormont Pa An object of the invention is to provide a process for the production of ferrosilicon which does not require the use of specially designed machinery but which may be carried out through the use of ordinary apparatus such as a regenerative coking oven and a regenerative furnace This process requires that the ore be in a finely divided state

METALLURGICAL PROCESS — J T JONES, 1104 Mississippi Ave Dormont Pa This process consists in crushing the ore to a fineness approximating twenty to one hundred mesh mixing with the crushed ore an excess of crushed coal of substantially the same fineness heating the ore and coal together substantially out of the presence of air to a temperature sufficient to coke the coal and to produce an agglomerated mass resembling coke and subsequently separating the metals from the coke

VULCANIZER—F D HOSTLER, I J HAMIEL and C H MATHER, address Hamiel & Mather Tipton Iowa The invention relates more particularly to a vulcanizer designed for connecting the ends of rubber tubes an object being to provide a device which facilitates the vulcanising operation either in the forming of a single or a double splice A further object is to provide a vulcaniser which is readily adjustable to the size of the tube to be vulcanised

Hardware and Tools

WRENCH—G C KOTRBA 2818 Cottage Grove Ave Chicago Ill. An object of this invention is to provide a wrench which will be capable of quick adjustment and at the same time capable of absolutely accurate adjustment so that it may be adjusted to fit any size nut, without any play in the movable jaw The wrench is simple and strong

DENTAL TOOL.—F GONZALES, 155 W 47th St, New York, N Y The invention aims to provide means which will permit the operation of the tool by the same hand which grasps the tool, thus permitting the freedom of the second hand of the operator A further object is the construction of a device in which any accidental disengagement of the cap from the stem of the chuck will be prevented.

COMBINATION SCRAPER, CHARGER AND TAMPER—T J AVERY, Albia Iowa An object of the invention is to provide in one tool means for effectively performing a plurality of functions ordinarily performed by a number of separate tools in blasting operations such as in coal mines. A further object is to provide a tool that can be used in placing and tamping an explosive charge in position for firing without any possibility of producing a spark

VALVE SPRING COMPRESSOR AND VALVE GRINDING TOOL—J K O'SULLIVAN, 1027 Park Ave Madison Ind The invention has for its object to provide a simple inexpensive tool of the character specified by means of which the springs of valves of the overhead and cage type may be compressed easily and uniformly and by means of which the valve may be ground

Heating and Lighting

OIL BURNER—J A LARSON, Spruce and Van Dine Ave Glendale, N Y The invention aims to provide an oil burner which may be used with extreme economy for commercial and house heating purposes, and by means of which primarily the volatile fluid will be more readily and thoroughly vaporised further insuring an intimate commingling and minute subdividing of the particles forming the fuel mixture

HEATING SYSTEM—P MCLAUGHLIN 520 Central Ave Dover N H Among the objects of the invention is to provide a heating system in which the hot air is utilised to vaporise water and direct the moisture laden air together with the direct heat units of the heating means through any approved system for heating purposes the air being directed by means of a fan or blower into and through the system which results in an economy of fuel and permits an effective control of the circulating medium

RETORT FOR EXTRACTING OIL, ETC — A V YOUNG Box 66 De Beque, Colo The invention relates to the extraction of oil gas, and other products from shale oil sand coal etc by destructive distillation and has for its object to provide a kiln and process for the extraction from ores and the like The process consists in heating the material to a sufficient temperature to drive off the gas, oil or the like and condense the gaseous products driven off

CLEAN OUT FOR BURNERS—L. FOLGMAN, 31 3rd St Brooklyn N Y This invention relates to self blowing torches. The primary object is to so construct the plugs or caps closing the ends of the fuel and retort tubes that a passage is presented in alinement with the passage through the constructed burner tube in order to facilitate the cleaning thereof

Machines and Mechanical Devices

LATHE CHUCK—H A BROOKS, Bainbridge Ga The principal object of the invention is to provide a chuck in which the clamps for holding the work may quickly be interchanged for those of other sizes so that work of various sizes may be quickly accommodated A further object is to provide a chuck made of two sections separably connected by means of a removable clamp the work clamps being retained within each section of the chuck.

DEVICE FOR OPERATING FREIGHT ELEVATOR HATCH DOORS—J E W FOGAL and C L SELGHUM, c/o Quincy Elevator Gate Co., Quincy Ill An object of the invention is to provide a device by means of which a pair of hatch doors, which are normally locked together may be unlocked from the car of the elevator one door moving upwardly and the other downwardly simultaneously both doors starting with a slow movement, gradually being accelerated and slowing up toward the end of the movement.

PAPER GRIPPING DEVICE—S BECKER, 1205 43rd St Brooklyn, N Y This invention relates to an attachment for printing presses. An object is to provide an adjustable paper gripping device, in addition to those already provided which will prevent paper throughout the greater portion thereof from rippling or billowing which provision insures the proper disposition of printing matter on the paper without disfiguration thereof

ATTACHMENT FOR WOODWORKING SHAPERS—W A. HENN c/o Peerless Tank & Seat Works, Evansville, Ind An object is to provide an attachment for woodworking shaper

having means for automatically holding the work to be shaped in contact with the cutting knives and for moving the work to occasion the shaping of the same in the manner required A further object is to provide a device that has means for automatically varying the speed of movement to compensate for differences in the hardness of different grades of wood when the knife is cutting against, or in the direction of the grain

PROFILE MAP MACHINE—E. S. CLARK, Walla Walla, Wash An object of the invention is to provide a machine to produce automatically a delineation on a record sheet of the profile of the road traversed by the vehicle on which the device is carried The machine comprises a pendulum mounted to swing on pivots in a vertical plane to the direction of travel, thus indicating the grade All the parts are mounted in a suitable rigid frame

PAPER FEED ALARM FOR ADDING MACHINES.—T P MARTIN, JR., c/o Stock Yard Nat'l Bank, Oklahoma City, Okla The principal object of the invention is to provide an electrically-operated alarm for an adding machine in which the paper itself acts as an insulator for separating a pair of electrical contacts which when the end of the paper approaches, are made to sound an alarm to apprise the operator of the need of a renewal of the paper

WASHING MACHINE.—H W WHITE, 837 W 6th Ave, Emporia, Kan The object is to provide a washing machine having a sediment collecting means in the form of a hopper bottom and a perforated plate above the bottom for supporting the clothes, together with a detachable receptacle below the bottom and to which the bottom delivers, the bottom having a baffle plate at the point of delivery

Medical Devices

HOLDER FOR DENTAL X-RAY FILMS.—J M MARTIN, 311 Wilson Bldg., Dallas, Tex. Among the objects of the invention is to provide a holder to which the film may be secured with facility and in a manner to securely hold the film, as well as to provide retaining members so formed as to blanket the minimum area, and thereby expose the maximum area for the clear viewing of the film The device is arranged for a single picture or two series totaling views of the complete mouth

Musical Devices

SHARPENER FOR PHONOGRAPH NEEDLES.—G W MAYER, 311 Grove St, Brooklyn, N Y This invention is arranged to enable the user to quickly and accurately resharpen a used needle or stylus Another object is to provide a sharpener which can be readily held in the hand and requires no other support. The sharpener is simple, durable in construction and not liable to get easily out of order

Prime Movers and Their Accessories

PISTON—C R RANDLE 475 East Ave 28, Los Angeles, Cal Among the objects of the invention is to provide a sheet metal piston for internal combustion engines having cast metal bases with flange and groove connection and also provide within the piston a piston head supporting brace with its base portion located against the piston pin bosses, whereby a maximum of strength and union of parts is insured.

GAS PRODUCER—D T SMITH, 40 Woodberry Grove, Finsbury Park, London, N 4 England This invention relates to a method of producing gas for supplying internal combustion engines. The object is to provide a producer of relatively light weight small size and high efficiency adapted to supply gas to internal combustion engines and the like, capable of adapting itself automatically to varying loads, and provide practically unvarying quality without distillation of the fuel

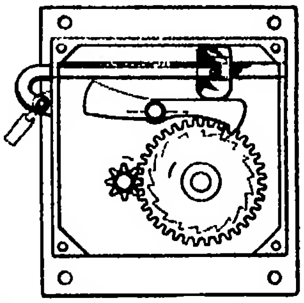
GAS MIXER.—C H BENNETT, Ben Wat Corp 245 W 47th St New York, N Y This invention relates to internal combustion engines, and has for an object to provide a mixer having means for improving the character of the mixture of gas and air used in an internal combustion engine by causing the small drops of vaporizable liquid ordinarily held in suspension to be broken up and vaporized

CYLINDER AND PISTON CONSTRUCTION—O S. PULLIAM, Park Row Bldg, New York, N Y The invention pertains more particularly to devices commonly employed in internal combustion engines. In this invention the cylinders are constructed in such manner as to carry the rings instead of the pistons, thus should the rings break the greatest damage which could be done would be a scoring of the piston a single piston when it became damaged could be replaced without the necessity of replacing the remainder which go to make up the engine.

Railways and Their Accessories

RAIL JOINT—J C. PEPPERS, 700 Jena St., New Orleans, La The object of the invention is to provide a rail joint of the chair type which is of simple and durable construction, reliable in operation and easy to apply, and which is especially adapted for use as an emergency splice, being capable of effecting a complete and safe union of broken rails without the use of bolts or similar fastenings and with a great saving of time and labor

CAR BRAKE CONTROLLING MEANS.—C R. ROCHAMBEAU, 1014 S. 16th St., St. Joseph, Mo. Among the objects of this invention is to provide means for controlling the operation of the drum or winding spindle for



A SIDE ELEVATION WITH FACE PLATE HAND WHEEL AND CHAIN OMITTED

railway car brake chains. More definitely stated the device provides a positive securing means for the locking pawl cooperating with the ratchet wheel associated with said brake drum

Pertaining to Recreation

TOY HORSEMOBILE—R. A. HUNARIAN, San Francisco, Cal. The invention has reference more particularly to a combined hobby horse and vehicle Among the objects is to provide a device so constructed that the rider will experience realistic conditions in riding the toy, with means whereby the steering wheels may be guided by the reins, and the propelling means being operated through the stirrup straps both the steering and propelling means being hidden within the body of the vehicle.

GAME APPARATUS.—M. M SMITH, 357 W 23rd St, New York, N Y An object of the invention is to provide a game affording considerable amusement and requiring skill on the part of the operator to produce desired results. The apparatus comprises a rotatable member having a rim and adapted to contain balls, passages extending from the rim at the lower portion, and receiving pockets at the upper ends of the passages for receiving the balls passing up the passage by centrifugal force, on the rotating of the member

AMUSEMENT DEVICE—J POPPER, 1614 Ave. M., Brooklyn N Y The invention relates to a device so arranged that it may be used as a toy or in advertising An object is to provide a reflecting device associated with a movable light in such manner that the moving of the light will cause the reflection to change in proportion to the movement of the light toward or from the reflector

WAGON.—F H. WARD, Washington, D C Among the objects of the invention is to provide a wagon which may be utilized solely for amusement purposes, and which presents for this purpose a wagon body which may be controlled so as to partake of a wave-like or rolling motion, relatively to the running gear which carries the body thereof

Something New in Ferries

(Continued from page 37)

electric units is able to function the craft can be run, but at reduced speed. This point is touched upon to bring out that the two engines and their dynamos must be incapacitated before the ferry is out of commission. The boat is intended to accommodate four lines of vehicles on each deck, and her overall length is 205 feet with a maximum beam over the guards of 68¼ feet.

An alternative design by the same technicists is for a craft of equal length and breadth but able to transport four lines of machines on the upper deck and six on the main deck. This ferry is to be propelled by bow-and stern screws actuated by electric motors. The operating current is to be supplied by two Diesel electric units each of 500 horsepower It is claimed that an automobile ferry of either of these types, compared with a vessel of like capacity driven by a steam engine, could be run for $2,000 less a month

A still later design, prepared by Messrs. Dickie, is for a double-deck ferry having an overall length of 220 feet and a maximum beam of 64 feet, and is intended to transport at one time anywhere from 80 to 90 automobiles on the main deck Again, oil-electric drive is to be the propulsive medium operating bow-and-stern screws, and a speed of 11 knots is expected The two propellers are to be revolved by independent motors, and when going ahead the after motor will develop 750 horsepower while the forward motor will be running at the rate of 71 horsepower, making a total shaft horsepower of 821 In other words, the bow screw will be rotated only fast enough to neutralize frictional resistance while the after propeller will assume the task of the ferry's drive There is reason to believe that this arrangement will make for economy, inasmuch as experience has revealed that the forward screw, when operating at full power tends to impede the advance of a vessel so equipped This is due to the rearward rush of the propeller's wake which augments the frictional resistance to be overcome by the craft

Probably the most unique scheme for an automotive vehicular ferry is that evolved by Mr vonRosen. His design calls for a twin hull or catamaran craft having a length of 320 feet with a maximum beam of 130 feet The spaciousness of the main and upper decks is such that the boat should be able to transport at one time about 320 vehicles, depending upon the size of the machines. With service of a mixed character, consisting of both pleasure cars and motor trucks, the heavier loaded conveyances would occupy the main deck while the lighter cars would be carried on the upper deck Cabin accommodations would be ample enough to take care of nearly 1,300 passengers.

The two hulls, each with a breadth of 30 feet, are bound together by sturdy girders supporting strong longitudinal beams, and the entire structure is deemed of sufficient rigidity to meet every likely stress with a generous margin of safety Because the two hulls are of fine model the designer expects to obtain a speed of 14 knots an hour with a total development of 8,000 indicated horsepower In each hull there would be placed a single reversible Diesel engine of 1,500 horsepower direct connected to shafting reaching fore-and-aft and turning a bow and a stern propeller, respectively Manifestly, the great beam of the catamaran hulls would insure notable transverse stability; and we are told that a ferry of this character would cost less to build than two smaller boats of similar combined carrying capacity Undoubtedly, the adoption of Diesel engines would make for operative economy.

The designer has arranged his two decks into a series of alleyways, and this is counted upon to aid in the rapid loading and discharging of the ferry without fear of confusion. Radical as the plan is from that of any existing ferryboats, still the vonRosen craft is of an order that may be looked for in the near future, especially where heavy vehicular traffic must be taken care of. Conditions exist today in some sections of the United States demanding a convenience of this sort. The question is: When will municipal authorities or public enterprise take the situation in hand and build the needful navigable links to bridge the hampering water gaps? Some are badly needed now.

Putting Green Sand to Work

(Continued from page 40)

At the New Brunswick plant, the method involves the heating of the sand with ordinary lime and water, which releases the potash from its union with the sand, transforming it into soluble and usable form. Every day 1,000 tons of green sand, 900 tons of quicklime, and 5,100 tons of water will be continuously pumped through large digesters, where the wealth of potash locked up ages ago will be released.

To supply the lime necessary for treating the green sand, pure deposits of limestone will be taken from quarries located in Sussex County, New Jersey Quarrying and crushing machinery will be installed to supply 1,700 tons per day of crushed limestone, which is to be transported to the New Brunswick factory, a distance of about seventy miles by railroad.

Interesting, indeed, are the methods used in the manufacture of the pure potash for the use of the farmers, the laundries, the soap factories, and of the countless other uses to which potash is put. For the burning of the limestone there has been built the largest lime plant in the world, consisting of ten great kilns, that have every appearance, when viewed from the front, of fourteen-inch guns.

The limestone, crushed from the quarry lumps to a uniform one-inch size, will be discharged from the railroad cars into an unloading hopper which feeds directly to a conveyor belt for carrying the material to small storage bins above the kilns, from which it will be automatically fed into the kilns.

A large crane is used for excess shipments, which are to be dumped and removed to a main storage space of 500 feet long by 150 feet wide and piled for use in time of interrupted shipments.

The hot lime discharged from the kilns will be cooled in rotary coolers and slaked at the end of the cooler with an excess of water, thus forming a lime slurry easily and cheaply transportable by pumps.

Later it will be shown how the residue is used, but mark how every little thing is utilized during the process of manufacture The lime kilns are to be heated by oil and the waste gases collected and used under waste heat boilers, thus producing enough heat to amount to fifty tons of coal daily.

The green sand, which is excavated from its beds by steam shovels, will reach the plant by barge in a fine, granular sandy condition, and will be unloaded by a giant crane already built. As in the case of the limestone, there is ample storage space to accommodate a supply, and the crane is of sufficient capacity to handle the normal demand of the grinding mills and take care of the storage. The green sand is conveyed to the grinding building where, mixed with water, it is ground so that 80 per cent of it passes through a 200-mesh screen.

The grinding occurs in tube mills. From the mills, pumps elevate the ground green sand pulp to a storage and measuring tanks, and then to mixing tanks where it is mixed with the milk of lime in the proper proportions. The charge having been prepared, the mixture is then sent through the digesters, where the conversion takes place. The "slurry," as it is called, is heated to 400 degrees Fahrenheit, which is the temperature

equivalent [illegible] 600 pounds of saturated steam.

To keep the water in the liquid phase, the slurry is put under sufficient pressure to prevent the formation of steam. It will be kept in the digesters a little more than an hour, which has the effect of releasing about three-quarters of the potash contained in the sand, but this is not "captured" until it is evaporated down in the large vacuum pans.

The specific type of digesters that will be used are those developed after long experimentation at the small factory run for the past few years at Jones Point. The factory at Jones Point is called a small one, but it handled 20 tons of green sand a day. The digesters consist of very strong steel cylinders thirty feet high through which the slurry will be continuously pumped day and night, month in and month out. Just before the slurry enters the digester it will be heated hot by the injection of steam under 500 pounds' pressure. The cylinders are chosen of proper size to hold the slurry for an hour or a sufficient time to effect the conversion of three-quarters of the potash in the hot slurry into a very soluble and easily "captured" form.

After leaving the digesters, the hot converted slurry will have its heat removed in special boilers in which the hot liquid is used as the source of heat and thus generates steam for the plant. The excess pressure of the slurry will be removed by friction in small pipes. The slurry, now cooled below the boiling point of water, will be filtered in standard filters and the liquid caustic potash thus obtained sent to the evaporator building for concentration.

In the evaporator building will be located the large quadruple effect evaporator, which is employed to concentrate the caustic potash. This evaporator consists of four sections each as tall as an ordinary three-story house, and it has a capacity of 5,000 tons of water evaporated in each twenty-four hours, utilizing exhaust steam exclusively, and using this steam four separate and distinct times.

Turning back to the residue that was separated by filtration from the caustic potash, useful by-products of the transformation of green sand are found. The excess of the lime and the silicates formed in the reaction are capable of a variety of uses, the most important of which is in the production of brick.

Already, millions of bricks have been made out of the residue. The process is quite simple. The residue is mixed with sand, and the resulting material is pressed into bricks. These bricks are then placed into hardening cylinders, where they are subjected to 150 pounds of steam for some hours to effect the reaction between the cementitious materials of the residue and the sand. These bricks have successfully stood exhaustive tests as to quality, and have been used to build some of the buildings at the New Brunswick plant.

The residue, carrying as it does about 40 per cent of lime together with considerable silica in a very finely divided form, will be marketed where lime is needed for sweetening the sour soils of New York, New Jersey, and Connecticut, as well as other states where the price of transportation is not too great. It is confidently expected that there will be markets for this lime-carrying residue to use 800,000 tons a year. The New Jersey Experiment Station located at New Brunswick also, is using this lime carrying residue on some of its experimental plots, and already its fine properties have been shown.

Our Latest Battleship, the "Maryland"

(Continued from page 41)

play the greatest possible stress on all parts of her machinery and equipment; but not the slightest trouble was experienced. In fact, naval officials declared the [illegible] like a boat that had been [illegible] four or five years, so

readily and easily did she respond in the tests.

Captain Charles F Preston, who has been assigned to the command of the 'Maryland," and was aboard during the preliminary trials, is most enthusiastic over the perfect performance of the new electrically-driven ship "Never on a warship that pleased me more in my 36 years with the Navy She is a wonder in every respect, the best warship in our Navy and the most powerful in the world," he declared, "I am highly pleased and satisfied with her electric equipment There is practically no vibration and sometimes I actually looked out to sea to learn if we were under power, so quietly and smoothly did her machinery operate"

Like her prototype the "New Mexico," pioneer *electric warship of the world*, the Maryland is electrical throughout. Her main propulsion machinery consists of two Curtis steam turbine generators, each designed to develop 11,000 kilowatts at a speed of 2,030 revolutions per minute to drive the ship 21 knots. These supply power to four 7,000 horsepower General Electric induction motors, directly connected with the four propellers and turning at 170 revolutions per minute The motors, among the largest ever built, are 12 feet in diameter, weigh 62 tons, and the 28,000 horsepower thus available for propulsion purposes is enough to supply power to a city of 100,000 population

The two turbine generators, supplied with steam generated by oil burning boilers, can be run independently Either *is capable of driving the ship up to a speed* of about 17 knots The power generated by them is used for no other purpose than propelling electrical current for other needs being generated by six 300-kilowatt turbine generators.

Virtually every electrical appliance used afloat and ashore has been installed in this new battleship The electrical equipment includes radio telegraph, loud speaking telephones, ordinary telephones, gyroscope compass, steering gear, anchor windlass, capstan, boat cranes, winches, air compressors, air heaters, turret training, turret gun elevating, ammunition hoists, gun firing, range signaling, powder testing oven, common deck fans, ice machines, laundry equipment, carpenter shop, lighting, visual signals, motion pictures, sterilizer in operating room, potato peeler, ice cream freezer and *other* kitchen utensils, bake ovens irons for laundry and tailor, storage batteries, motor boat ignition, etc

It is probable that no ship built by any nation in the past has been so thoroughly equipped for the comfort and convenience of the crew

A completely equipped hospital will be maintained on board with navy surgeons to look after the health of the crew and a dentist to look after the men's teeth A chaplain will be assigned to the ship to hold regular church services and to devote his time to spiritual welfare of the officers and men.

The 'Maryland" is third in order of completion of the electrically-propelled battleships for the navy She was built by the Newport News Shipbuilding and Dry Dock Company and the electrical equipment was designed and manufactured by the General Electric Company

The ship was launched on March 20, 1920 Her chief characteristics are

Length	624 feet
Beam	97½ feet
Draft	30½ feet
Weight	32,000 tons
Speed	21 knots
Number of propellers	4
Shaft horsepower	30,000
Oil capacity	1,400,000 gallons
Oil burning boilers	8

Three more battleships of this type are being built the "West Virginia" to be ready for her trial trips in 1922, the "Colorado" and the "Washington." In addition the Navy is building six 43,000-ton, 60,000-horsepower battleships and six battle-cruisers, the latter rated at 180,000 horsepower each, which makes the propelling machinery six times as powerful as that of the "Maryland" Both of these types of warships will carry 16-inch guns will be electrically driven

Production of the electrical machinery for several of these vessels is now progressing under the direction of W L R. Emmet, who advocated the principles of the electric drive as long ago as 1909, was instrumental in its adoption by the Government, and designed the first electric drive installed by the Navy on a battleship, now working so successfully on the U S S "New Mexico"

Something New in Salvaging Equipment

(Continued from page 41)

finally sold to the second salvage concern for $10,000 and the present operation undertaken. While no figures are yet available, it is believed it cost a relatively small sum to raise the vessel this time It is estimated the wreck is worth about $100,000, besides a valuable cargo of paint.

It is predicted that the new equipment *not only greatly* reduce the cost of salvaging vessels, but will make possible the salvaging of many vessels which could not hitherto be raised

The "mole," upon which the new system principally depends, consists of a watertight steel housing for two electric motors, each of which drives independently and in opposite directions a screw propeller of slight pitch and at slow speed The propellers are in front and a broad steel rudder is located in the rear of the machine It trails behind it a control cable and a steel lifting cable or chain By varying the speed of one motor or the other as well as the inclination of the rudder the direction of the machine may be changed at will by the operator while burrowing in sand. In preliminary tests the machine burrowed through dry gravel under good control

The operator is provided with a complicated control board, with instruments which indicate the exact position of the "mole' at all times Colored lights indicate whether the machine is on an even keel or not and whether it is traveling up or down. An electrical stethescope is provided and it is claimed that a trained operator can determine, by listening in this, just what is the nature of the bottom through which the "mole" is traveling and can tell at once when an obstruction of any kind is encountered

It is necessary for a diver to descend with the "mole' to see that it is properly started on its journey under the ship As soon as the two propeller screws emerge from the bottom on the other side of the wreck, they of course have no traction and the machine has to be hoisted up the rest of the way The diver must locate the "mole" as it emerges, and to aid him in this the machine is equipped with a tapping device which guides him to it by sound.

Once the lifting cable is passed under the vessel pontoons are attached to each end, and when a sufficient number of pontoons are ready in place, they are simultaneously pumped full of air and the vessel *is lifted from the bottom*

The pontoons deserve special attention Instead of the conventional wood or metal construction, they are veritable underwater balloons, being constructed along identical lines with an air balloon. The pontoon consists of an inner rubber envelope which is covered with heavy canvas. The whole is enclosed in a heavy mesh bag of ropes to which the lifting cables are attached. An essential feature of the pontoon is a compensating valve which gradually diminishes the air pressure in the bag as the pontoon approaches the surface.

LEGAL NOTICES

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When the pontoons are used at considerable depths an enormous air pressure is necessary to overcome the great water pressure. But as the pontoon rises the pressure on it diminishes, and unless the internal air pressure were relieved it would be sufficient to burst the bag. Each pontoon is said to have a lifting capacity of 25 tons and it is a simple matter of calculation to determine how many will be required to raise a vessel. It is thought double or triple rows of pontoons would be necessary to raise some of the largest vessels.

The wooden or metal pontoon has always had the disadvantage that it could not be used in high seas because of the danger of damaging both pontoon and wreck by bumping together. It is claimed that the new pontoon, on the contrary, will act as a buffer to protect the wreck after it has been raised and while it is being towed to drydock.

The inventor claims for his devices the ability to work in very deep waters, where salvage operations are now considered impossible. His contention, of course, remains to be proved. The fact that the diver has to do nothing but see that the machine is started right and to hook on a line when it emerges from the other side, will make it possible it is said, to equip him with one of the rigid types of diving armor which hitherto have been of very little use because they so restricted the movements of the workmen.

If this feature of the device proves practicable, a veritable treasure-mine will be opened to the salvager. In spite of the fact that the vessels raised since the war, especially in European waters, represent an enormous fortune, most of the known sea wrecks lie at depths at which a diver cannot work. The chief advantage of the system appears, however, in the fact that all of the equipment can be carried in a single tug-boat and the fleet of vessels ordinarily required in raising a wreck are dispensed with. The cost of salvaging is materially reduced and the time required is much less, if claims are born out in future and more difficult operations.

How Much Air for the Tunnel?

(*Continued from page 42*)

adjustable openings into continuous expansion chambers on each side of the roadway proper, from which the air will escape into the tunnel. The exhaust duct located above the roadway and connected with the exhaust fans at the shafts will be provided with openings of varying sizes equipped with adjustable shutters as shown in one of the accompanying photographs. By making the openings for the intakes and outlets adjustable, it is possible to regulate the volume of air supplied and withdrawn so as to meet the requirements of the traffic.

More than 115 tests have already been completed at Champaign, Illinois, where the model duct is located. Despite the fact that this midget structure is only 400 feet long, it is of such construction that its various sectors can be made to represent any particular portion of the real duct which the engineers wish. Special stress has been laid on a study of the losses in downshaft elbows as the air wastes are very high in the elbows and bends that connect the fans with the tunnel ducts proper. Similar emphasis has been placed on the study of the outlet ports or expansion chambers along the roadway to ascertain the losses of outlet air from the duct to the roadway. There are 224 of these outlet ports in the experimental duct and special pains have been devoted to the determination of the most satisfactory spacing of these ports from the standpoint of construction and air delivery.

A 300-horsepower, electrically-operated fan is used in this pocket edition of the Hudson River tunnel, this fan producing 100,000 cubic feet of air per cubic inch. Special electrical recording devices are so arranged in the tunnels that readings can be obtained from them which show the exact air pressure at all parts of the tunnel for the duration of the test periods.

There are four observation stations at regular intervals along the length of the tunnel where engineers remain and make readings during the test periods. The apparatus for recording the air pressure readings at various places in the test tunnel centers in these stations. Although this remarkable duct was constructed only for the tests now in operation and will be rased about August 1, 1921, when the experimental work will be completed, it has served a very useful purpose and has been responsible for the practical solution of tunnel ventilation and air friction problems which, otherwise, would have remained intricate enigmas.

The Summer Sneezer

(*Continued from page 45*)

with protein of feathers to cure her, but she is now not only tolerant of birds, but keeps a parrot as a pet! A New York dramatic critic suffered agonies whenever a cat entered the room. His affection took the form of nausea, and he found it impossible to visit his friends who kept cats lest he should be obliged to make a sudden and unexplained exit. His case, too, was complicated by attacks of "hay fever" whenever he came near a horse. Diagnosis in this case was perfectly simple, and a protracted course of treatment with subcutaneous injections of serum prepared from the protein of cat hairs and horse dander effected a permanent cure.

Some of the susceptibilities that give rise to the 'hay fever' symptoms are very readily removed by treatment, in most cases. This is especially true when the infection is due to the pollens of plants. One can obtain a diagnosis that identifies the particular pollen to which the patient is susceptible, and the curative treatment does not have to be administered by a physician, after the first prescription, as the protein preparation for immunization or "desensitizing" can be taken by the mouth.

The careful physician today warns the parents and families of persons who can not tolerate the presence of certain animals or eat certain food that such things are not vain imaginings, whims, fancies or 'nerves," but actual illnesses for which a child should not be scolded or laughed at but taken to an up-to-date physician of a modern diagnostic clinic for precise diagnosis and curative treatment. And the hay fever sufferer who goes on suffering year after year has only himself or herself to blame.

Clusters and Nebulae

(*Continued from page 46*)

that they are very numerous, one authority estimating them at 120,000, another puts the number at 500,000. A recent pronouncement of a Lick Observatory authority specializing in nebulæ is to the effect that their great Crossley reflector is able to reveal 700,000, perhaps a round 1,000,000 or more.

Now the spiral nebulæ not only "avoid" the Galaxy, their number increasing roughly as observation passes from low galactic latitudes to high ones, but they seem in fact to be actually in motion away from the galactic plane. They are not only leaving it, but are rushing away. On the other hand, the globular clusters are hastening toward it. The concentration of the one class near the pole or poles and of the other class near the equator appears to suggest that the movements are far advanced. These results appear to be facts. If they are really thoroughly confirmed by future investigation and the exceptions reconciled with them, then these facts will assume remarkable importance. On the surface, they are large conceptions. Hidden back of them must be truths of enormous significance.

Man-Made Precious Stones

(Continued from page 48)

sure In principle, his process consists of dissolving the carbon in iron brought to a temperature of about 3,000 deg in an electric oven, then in cooling this solution quickly by plunging the crucible which holds it in water, melted lead or mercury The outside surface of the mass, the first to solidify, becomes a rigid prison in which the cast iron, still liquid, cannot expand and will thus be submitted to great pressure Liquid cast iron possesses the property of increasing in volume as it solidifies. The carbon, finding its space limited, instead of taking the form of graphite, as it does in iron melted in huge furnaces, crystallises and becomes a substance like the diamond, with a much stronger density The diamond made in this way is then separated from the surrounding crust by the application of hydrochloric, sulfuric and nitric acids.

In order to attain the high temperature necessary for this process, Moissan invented a special electric oven This oven consists of two huge blocks of quick lime or magnesia standing on end, but so arranged that they can be laid one over the other The lower brick has a longitudinal groove in which two electrodes are placed Above the huge electric arc lamp which these electrodes make is a crucible in which the substances are placed When the heavy electrodes are brought together, the arc flashes on with an impressive noise Long flames escape at the sides, throwing out blinding light. An enormous quantity of electricity is transformed into heat The functioning of this furnace costs not less than four or five francs a minute, so that the diamond produced in the laboratory costs very much more than the natural gem For this reason the manufactured diamond is not popular

Needless to say, it is a far cry from a laboratory experiment to an industrial product So long as precious stones are obtained more easily and at less expense from mines than from chemists' crucibles and electric furnaces, their manufacture will not become a thriving commercial industry

Compound Gearset Design

(Continued from page 50)

If the clutch member is shifted so that it engages projections on the face of the larger gear the lower speed will be secured on account of the great difference in diameter of the driving pinion on the primary shaft and the driven gear on the countershaft. Two shift members are provided on the main shaft, the larger one of these giving the reverse ratio and the low speed, while the other one will give the second speed or direct drive just as in the usual three-spread transmission. For example if the positive clutch is shifted over toward the rear end of the transmission until it engages the smallest of the two countershaft driving constant mesh gears the ratios ordinarily provided by a gear box of conventional design are obtained, *i e.*, three forward speeds and one reverse, depending on the location of the shifting gears on the main shaft

In the illustration showing the smaller countershaft driving gear clutched to it, the large shifting member on the main shaft is engaged with the small pinion on the countershaft that provides the slow speed ratio. If these gears are left in the position shown, and the jaw clutch member is shifted to the other extreme so that the large constant mesh gear is clutched to the countershaft we still have a low speed ratio but one that is considerably lower than that previously obtained on account of the primary reduction in speed obtainable by the differing diameters of the constant mesh gears then employed In the illustration showing the high speed and intermediate shift member engaged with the projecting teeth on the face of the larger of the constant mesh primary shaft driving gears the jaw clutch on the countershaft is depicted in engagement with the large countershaft driven gear. When in this position we obtain a direct drive because it makes no difference under these conditions which of the countershaft gears is engaged by the positive jaw clutch. The drive is direct from the engine end to the drive end of the main shaft because the primary or spigot shaft is clutched to the extension of the main shaft of which it forms a part. On the lower gear ratios however, and when the reverse gears are engaged, it makes considerable difference in the speed reduction if one or the other of the constant mesh gears mounted on the countershaft is clutched to that member because on the lower speed and reverse ratios the countershaft comes in to use. Unless clutched to the countershaft by the jaw clutch, the constant mesh members revolve independently of it.

NEW BOOKS, ETC.

A LABORATORY MANUAL OF ANTHROPOMETRY By Harris H Wilder, Ph.D Philadelphia P Blakiston's Son and Co., 1920. 8vo., 193 pp.; 43 illustrations.

Simplified and revised from the author's working rules in manuscript, this manual contains the adopted prescriptions of the International Congress of Anthropologists, with the enumeration of instruments, and a description of the mathematical methods in general use. Footnotes guide the student to the important sources upon which the book is based Part I treats of the measurement of bones, including the skull, Part II of the measurement of the body Measurements of Indian skulls, and bodily measurements of female college students are tabulated in appendices.

LABOR'S CRISIS. By Sigmund Mendelsohn New York The Macmillan Company, 1920 12mo, 171 pp

An employer here gives his views of the problems of labor which, as he remarks, now concern the welfare of society more than of labor The chief problem has shifted from that of adequate wage to that of inflated wage, and from an oppressed suffering class to a militant one striving for economic dominance He admits that the situation is intensified by the employer himself He advocates deep study of these questions at close range. The work is a level-minded presentation of both sides of the shield, and is worthy of a wide reading.

CHEMISTRY AND CIVILIZATION By Allerton S. Cushman A.M., Ph.D Boston Richard G Badger, 1920 8vo, 151 pp, illustrated

Dr Cushman, for ten years in charge of research work in the U S. Department of Agriculture and later in charge of the manufacture of explosives at Frankford Arsenal, has treated his present subject in a striking manner Using the history of chemistry as a background, he builds up scientific achievement as an edifice devoted to the progress and welfare of humanity He has so written that the general reader as well as the student of chemistry may find edification in the narrative.

LABORATORY EXPERIMENTS IN ORGANIC CHEMISTRY By E. P Cook, A.M Philadelphia P Blakiston's Son and Company, 1920. 12mo, 88 pp., illustrated.

Designed especially for use with Stoddard's "Introduction to Organic Chemistry," this text, now in a second edition, presents experiments for a first course that illustrate and emphasise important methods of preparation of organic compounds, show typical reactions for each class, and instruct the student in the details of laboratory work. The course has been followed with success in Professor Cook's classes at Smith College.

AMERICAN RURAL HIGHWAYS. By T R. Agg, C E. New York McGraw-Hill Book Company, 1920. 8vo.; 189 pp., illustrated.

"American Rural Highways" assumes familiarity with drawing and surveying, and provides a good short course for agricultural engineers and students of agriculture. The relationship of highway improvement to national progress is made clear, and the problems of highway administration are set forth, with accepted methods of design and construction, so that the student is familiarized with the distinguishing characteristics and relative serviceability of the common types of road surface.

IN THIS ISSUE: MOLYBDENUM STEEL IN THE MOTOR CAR
WHAT MAKES THE GLOW-WORM GLOW?

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

PULLING THE MISSISSIPPI'S TEETH: HAULING A HEAVY SNAG ABOARD —[See page 60]

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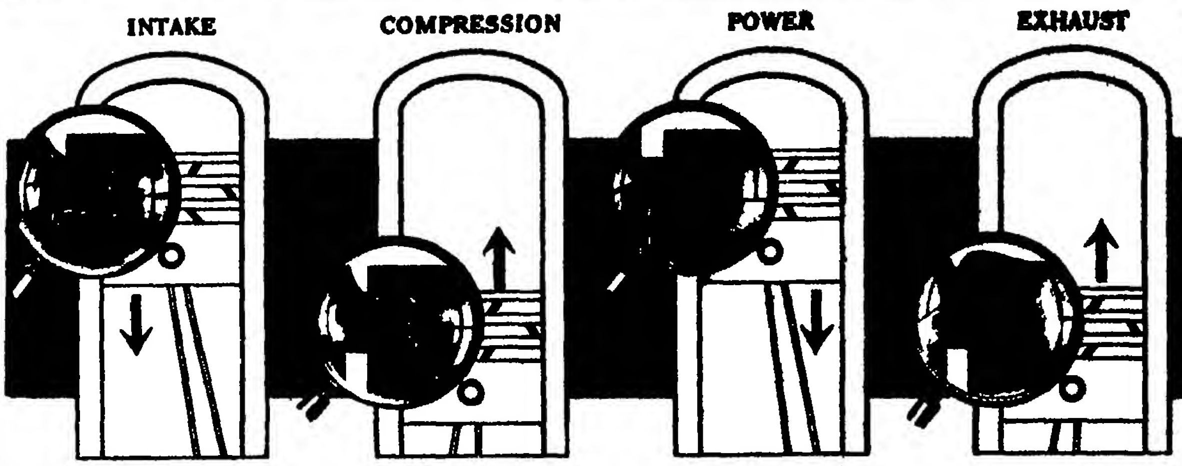

Piston moves downward. Worn ring at top of groove.

Piston moves upward. Worn ring at bottom of groove.

Piston moves downward. Worn ring at top of groove.

Piston moves upward. Worn ring at bottom of groove.

NO

Heavier Oil can never replace metal worn away

YOU are sometimes advised "As your automobile engine becomes worn use a heavier oil Heavier oil, some people will tell you, provides a better seal for clearances enlarged through wear

But first consider these facts

As your car grows older, metal is worn away by the wear between moving surfaces Will heavier oil replace this lost metal? NO

The oiling system of your engine was designed specifically to circulate lubricating oil of a certain body Will this oiling system—pump screen, oil pipes, etc—distribute as effectively a heavier oil? NO

Any oil whether heavy or light, when used in worn engines will work past the pistons and piston rings and enter the combustion chambers forming carbon The heavier the oil, the more aggravated will usually be the carbon deposit

What are the wise and only proper measures to take when your engine is badly worn? Obviously, have the bearings adjusted, have new pistons and piston rings fitted, and *continue to use the correct grade of oil for which your engine and oiling system were designed*

This whole subject of engine wear and heavier oils is dealt with in our folder, "Lubrication—Its Relation to Engine Wear" Rather than invite additional repairs and trouble through the use of too heavy oil, it will pay you to write to our nearest Branch for a copy of this paper

WORN RINGS
cause Carbon Deposits

Worn piston rings move perceptibly upward on the down stroke of the piston; the oil accumulates under and behind the rings Then as the piston moves upward the rings move to the bottom of the recess, forcing the oil by the rings This is sometimes termed oil pumping The oil ultimately reaches the combustion chamber causing carbon deposit

* * *

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SCIENTIFIC AMERICAN

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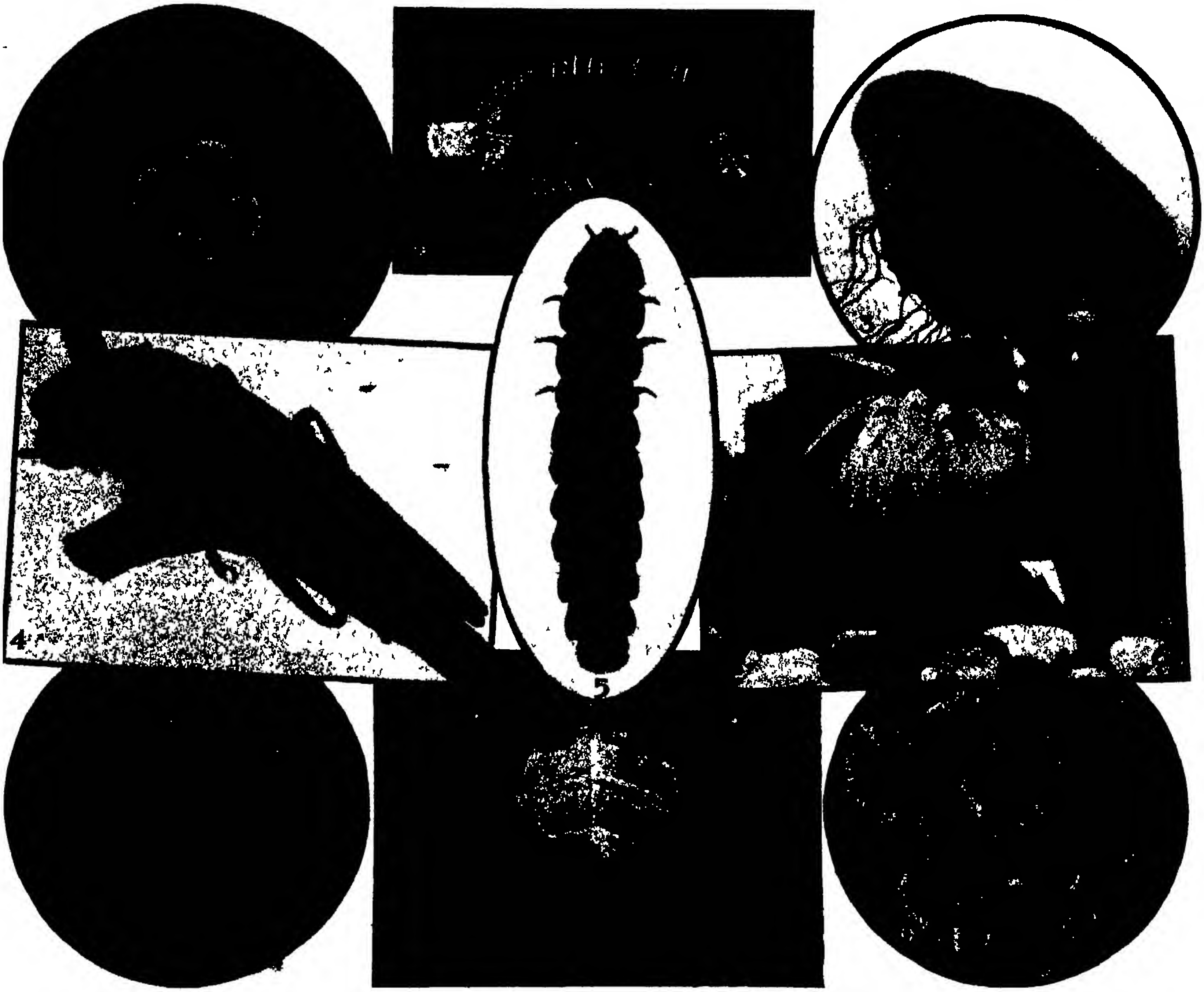

1 Aurelia, a jelly-fish. A phosphorescent animal 2. Polynoe, a marine worm. This animal is covered with scales that glow with a brilliant blue light when the creature is disturbed. It is shown here with proboscis extended which it uses in seizing its prey 3 Cyanea, a jelly-fish. A common cause of luminous flashes in the sea. 4. Photuris, the common firefly 5. The glow-worm. This animal is not a worm but the larval form of the lampyrid beetle photinus, a common firefly 6. Sagartia, the white sea-anemone Erroneously believed to be phosphorescent. The luminosity of this animal is due to the ingested phosphorescent organisms which it captures with its flower-like tentacles. 7 Noctilucas, the microscopic animals which in large numbers cause the phosphorescence of the sea, greatly magnified. 8. The Lantern of the firefly 9. Luminous scales of the sea-worm polynoe. These curious plates are thrown off by the animal on the slightest provocation. They are bathed in a luminous secretion which glows intensely when the animal is disturbed.

SOME OF THE LIVING LAMPS THAT SHINE BY NIGHT: VARIOUS FORMS OF LIGHT-PRODUCING SEA LIFE AND INSECT LIFE—(See page 65)

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Aviation Fatalities

IT WOULD be folly to shut our eyes to the fact that the success of commercial aviation is being delayed, if indeed it is not actually being jeopardized, by the frequency of fatal airplane accidents It may be that the percentage of accidents in relation to the total mileage of flights is no greater than it was but to the general public it must seem as though the number of people killed is disproportionately on the increase The undermining of public confidence in the safety of flying is increased by the fact that so many of the recent fatalities have happened to highly experienced men, both in this country and abroad The grievous accident when seven people were killed near Langley Field, the recent crash of a brand new army bomber, the death of such men as Alcock who flew the Atlantic and now of Hawker who made a gallant attempt to do so have left an inevitable impression of the risks of flying, even when it is in the hands of the most competent pilots

All these mishaps notwithstanding, there is not the slightest doubt that the art of aviation has come to stay For naval and military purposes it is already invaluable—more than that it promises to absolutely control the strategy and tactics of the future both on land and sea As between military and commercial flying, however, there is this broad difference that in the one, enormous risks must be taken and death is one of the major chances of the game, whereas in commercial aviation, the public looks for, and has a right to expect, the same degree of security that attends commercial transportation on sea or land

We do not hesitate to say that the future of commercial flying, at least so far as passenger travel is concerned, depends more than anything else upon the confidence of the public When the would be traveler is satisfied that he can use the swifter means of travel by way of the air, with a degree of security which at least approximates that of travel by steamship, train or automobile, the commercial future of aviation will be assured, and never till then

A member of our staff who was in the flying service during the war and has a record of 1500 hours in the air, believes that a large proportion of airplane fatalities are unnecessary and therefore preventable He holds as a fundamental condition of safety, that every pilot should have a sufficient degree of knowledge of the construction of an airplane, and of the stresses to which it is subject, to enable him personally to detect any oversight of inspection by the ground force In theory the system of inspection by the ground crew is excellent, in practice there is danger of the inspection becoming perfunctory and therefore more or less careless It is so in all lines of human activity and in spite of the frightful results which may follow upon careless oversight, a ground crew is after all human—a fact which the pilot should never lose sight of, and against which he should guard, by developing his own mechanical competence and giving his machine a careful personal inspection before taking off

Another suggested improvement is in the matter of periodic overhauling Under the present system this takes place after a certain number of hours in the air The method is too general, it should be made more specific, it should vary both with the plane and with the character of the service in which for the time being it is engaged Ninety hours of one hour flights is not so severe on the machine as ninety hours of three hour flights. Frequency of inspection should vary, also, with the atmospheric flying conditions, and should be more frequent in stormy weather or when the flights are made over mountainous terrain.

As regards the human element, when once the machine is in the air for any but military service, there should be a stern prohibition of so called "stunt" flying, which confers no practical advantage upon the pilot and imposes stresses upon the machine that are unnecessary, that are too little understood, and that may and frequently do, result in a crash. Aerial gymnastics, if they had the sole effect of delighting the crowd and incidentally swelling the gate receipts, might be as unobjectionable as any other form of sport or entertainment that involves personal risks. Unfortunately, disastrous dare-devil flying ending in the death of the pilot, is a direct blow at the confidence of the public in commercial flying Of this there can be no doubt whatsoever, and for this very practical reason we would like to see a combined movement of airplane associations and manufacturers to put a stop to this kind of public performance

We have said nothing thus far about those two great fundamentals for safe commercial flying, namely—the provision of many and well found landing fields and the comprehensive radio dissemination of meterological warnings. With these two necessities provided, and with a well thought-out system of Governmental laws and regulations, coupled with eternal vigilance in the matter of inspection, we should quickly reach the stage where travel by air would be as safe as travel by land or sea

Sea Power in the Pacific

WE have before us a book, "Sea Power in the Pacific, which has the double recommendation of being not only comprehensive, exact, and well written, but of making its appearance at a period of international affairs when just such a work as this is needed The author, Hector C Bywater, is one of those English lay critics who have done so much in past years for the British Navy, by keeping alive public interest and by stimulating Government action through intelligent constructive criticism.

The changed international conditions and the shifting of the center of gravity in naval affairs are well stated in the opening sentence of the book ' When the German High Sea Fleet surrendered for internment on the 21st of November, 1918, a brief but pregnant chapter in the history of sea power was brought to a close The next chapter may be said to have opened in August, 1919 with the passage of the newly created United States Pacific Fleet through the Panama Canal, en route to its base in San Francisco Bay "

After showing in some detail the gravitation of sea power from West to East, a movement which began with the Chino- and Russo-Japanese wars, the author discusses the questions at issue between Japan and the United States. As a summary of the outstanding disputes, we know of nothing which compresses the whole story into a limited space so well as this chapter which, by the way, is written without prejudice and with marked fairness. The two chapters on the modern development and administration, and on the men and material of the United States Navy, form an admirable compendium. Nothing that is essential to the subject has been omitted, and many facts that will be new to American readers and that should be known to every well wisher of our Navy are herein set forth

Then follow successive chapters on the inception, growth and purpose of Japanese sea power, on the administration, dock yards and shipbuilding resources of the Japanese navy, on men and ships of that navy and finally a chapter on Japanese torpedo-craft, submarines and aircraft

Unquestionably the most interesting part of this book is two succeeding chapters, one entitled "Strategy in the Pacific," and the other "Possible Features of a War in the Pacific." To the lay mind, the facts here brought out by Mr Bywater, will be as unwelcome as they are sensational, although they have been well known to the officers of our Navy and have formed the subject of much study in our Naval War College for many years past At the close of the Spanish-American War, when, in 1898 we took over the Philippines and Guam, the SCIENTIFIC AMERICAN pointed out the enormous naval significance of this action. We stated that, literally, we had given hostages to fortune and that, by the acquisition of these far-distant possessions, we had entered into the field of international politics and should be under the necessity of increasing our naval and military defenses accordingly.

Unfortunately we have failed to supply either the Philippines or Guam with modern fortifications and, as Mr Bywater sees it, in the unhappy event of hostilities with Japan, we should stand to lose these possessions at the very outbreak of a war Ultimately, as he points out, we should of course retake them; but because of our neglect and the lack of balance in the make-up of our Navy, even though the enemy would be ultimately crushed, the duration and the cost of the war would be greatly increased.

It is needless to say that this book was written before President Harding had sent out his call for an international conference on disarmament, in which the adjustment of the various problems of the Pacific will form one of the primary subjects of discussion.

A Better Merchant Marine Outlook

EVERYONE who has the interest of our merchant marine at heart should feel greatly encouraged to know it is now controlled by a man who has a well-proved record as an executive and who refuses to be daunted by the great problems confronting him. He has the confidence and good wishes of the American people at his back. The magnitude of his task is equalled only by the fine opportunity which it presents for doing a great constructive work for American shipping

The Chairman has told us that he has a double object in view First, to build up a large shipping business over the routes which have already been laid out by the Shipping Board, and over new trade routes which are yet to be determined upon. At the same time he will endeavor to strengthen the private owners, so that ultimately they will be in a position to buy outright the ships which are now owned by the Government.

As a result of the consultations between the Shipping Board and the operators and owners, the latter made several recommendations of men who are experts in the shipping business and allied lines of effort, and from these the Chairman has chosen three of the ablest, who will serve as vice-presidents under him in the Emergency Fleet Corporation, as it will be called There will be two other vice-presidents, who will act respectively as chief counsel and as the active agent in the sale of the ships and the salvage of material—vast operations, when we remember that there are claims aggregating over half a billion dollars against the old Shipping Board, and that the ships to be sold cost nearly four billion dollars.

The Chairman tells us that the very first thing to be done is to straighten out the badly tangled affairs of the Shipping Board So vast is this concern and so multiplied are the ramifications of its business, that the task will provide work for a large staff of lawyers for a long time to come. One definite step looking toward liquidation is to be taken at once—the whole of the fleet of wooden ships is to be placed on the market and sold at whatever it may bring. It is hoped that some of these will find their way into our coasting trade, and that what we do not take will be purchased for the coasting trade of other countries, notably of Norway and Sweden. Many of the ships, because of the haste with which they were built and the green timber that went into their hulls, are so far gone as to be useless even for the coasting trade. With their engines and boilers removed and their upper decks cut down they might be serviceable for barges. On the other hand, there must be many ships that were built in the best and most experienced yards, and that could be bought for a price so low as to justify a thorough overhaul and outfitting.

In forecasting the success of the new shipping regime we must remember that the evil days upon which foreign shipping has fallen will tend to soften the severity of the competition from that quarter. In the matter of regaining our once proud position as a maritime nation, it is now or never. "There is a tide in the affairs of men, . . ."

Aeronautics

Aerial Time Tables.—So important has become commercial aviation in France that there is being published a monthly time table of all the air services operating in France and allied countries. This time table known as *L'Indicateur Aerien*, gives such information as the time of departure and arrival, routes, type of plane employed, weight of luggage allowed, rates, and so on. The little publication appears on the first of every month.

The New Handley-Page Monoplane, which is at present under construction, has been designed specially for the Handley-Page slotted wing, and the slot will be capable of being opened and closed at will Not much can be said regarding the machine at present, but we understand that the engine will probably be a 350-horsepower Rolls-Royce "Eagle" low-compression engine, and the speed is expected to be more than 100 miles per hour. The cabin is designed to seat ten to twelve passengers.

London-Paris Flights.—A new type of flying machine has recently been tried for the London-Paris service. It is a Vickers-Viking amphibian machine, which is a form of seaplane having adjustable wheels so that it can land on water and run on to the shore. By the use of this type of machine it becomes unnecessary to travel to the outskirts of London in order to take an airplane. The possibilities of landing at any time in case of mechanical trouble are much more favorable, as the Thames and the Seine offer landing facilities at almost any point.

Locating Oil by Airplane appears among the latest aerial novelties. In this case we have reference to a British oil concern that is using two flying boats to survey the delta of the Orinoco River in Venezuela It appears that oil-bearing lands in this part of the world are distinguished by the partial destruction of the vegetation, and it is believed that an aerial photographic survey of the region will afford a rapid method of both locating oil fields and of discovering the most suitable forest paths and waterways for an approach to the fields. An opening is cut in the boat bottom to allow the camera lens a view, and this hole is fitted with a water-tight manhole cover secured by a kind of breech-block action. The camera can be raised or lowered into position.

Aerial Photography in Hydrography.—Attention is called to the importance of the paper submitted to the French Academy of Science by M. Volmat, in which he gives particulars of aerial photographic experiments carried out from a hydro-airplane, and emphasizes the importance of such a method in drawing up sea charts, so as to obtain quickly and exactly particulars relating to the lay of the coast, the conformity of shoals discovered at low water, etc. In the tests carried out 17 meters below zero on the chart was the greatest depth at which the bottom could be clearly seen. Great depths produce a characteristic surface movement of the waves. From the impression on a photographic plate of wave action it has been possible to discover a point of rock 8 meters below zero.

The Lust for Speed.— According to *L'Air*, France is still concerned with the problem of producing speed airplanes capable of defeating the existing world's speed records, the laws of resistance, and possibly the abilities of the best pilot to land on any airdrome smaller than the Gobi Desert. It is stated that in a certain number of new monoplanes, possessed of engines of anything up to 600 horsepower, thick wings, retractable undercarriages, and the absence of outside bracing, the constructors are hoping for a speed of 220 miles per hour, with a mere landing speed of anything over 125 miles per hour The firms concerned are Nieuport, Spad, and Hanriot, and it is hoped that their efforts, at any rate to produce a really fast machine, will give rise to some remarkable constructions.

Deutsch de la Meurthe Cup.—Madame Henri Deutsch de la Meurthe and her family have decided to offer, in memory of M. Henri Deutsch de la Meurthe, a sum of 200,000 francs for an international speed contest to be called the Coupé Henri Deutsch de la Meurthe. The cup will be contested under the conditions laid down in the present regulations which have been drawn up at the request of the donors, and with their approval, by the Commission d'Aviation of the Aero Club of France. A sum of 200,000 francs will be distributed as follows: (a) An *objet d'art* of 20,000 francs. (b) Three prizes of 60,000 francs, each to be awarded to the winners of the cup, in accordance with the present regulations. The cup will be contested each year on a date and at a place set by the special regulations for the year.

Science

Memorial to Sir William Ramsay.—The Dean and Chapter of Westminster Abbey are to place a bronze medallion in the edifice for a memorial to Sir William Ramsay

An Elevator for Bathers.—Atlantic City's newest hotel has a special elevator running to every floor for the convenience of bathers who can reach the beach by means of a tunnel under the board walk They can come up dripping to their rooms without destroying the fine clothes of the neighboring guests.

Early Meteorite Records.—It is a curious fact that there were fourteen falls of stones or earth in Central Italy in forty years from 208-168 B C as noted by Prof W M F Petrie in a recent issue of *Nature* It appears that the earth was then passing through a region of aerolites. The references in Livy are under the years A U C 545, 548, 550, 558, 559, 561, 564, 567, 575, 579, 580, 583, 584 and 585

Hunting for Quipe.—Professor W W Rowlee and George W Mixter have sailed for South America for an exploration trip into Ecuador Professor Rowlee, who is an authority on woods, goes in quest of quipe timber, great quantities of which he believes grow in Ecuador Quipe is a very light, buoyant wood which is used extensively as a substitute for cork in the manufacture of live-preservers and similar articles.

Vacuum Cleaner Routs Bug Army.—When the commuter appeared in his front yard with the longest nozzle, meant for the picture moldings, attached to his vacuum cleaner, the neighbors were surprised, but his explanation was sound, he stated that he did not intend to vacuum clean the leaves, but there had been bugs on the trees for days, which were too slender and young to stand the weight of a ladder against the trunk and he did not have a spraying outfit So he picked the bugs off the top branches with the vacuum cleaner

Origin of the Guinea.—The mystery of that dreadful uncoined unit of barter in England known as the "guinea" which is abstracted from the pocket in place of the pound very much to the damage of the metric and all other systems seems to have been solved at last. Now the pound is 20 shillings and the guinea is 21 shillings so that it is cherished by hotels and lodging houses because it is divisible by seven This is good as far as it goes, but why does a London doctor charge a guinea a visit when a quarter less (when exchange is normal) would do as well?

Beginning of Disaster on Mt. Everest. — Mount Everest has claimed her first victim, Dr A M Kellas, a world-renowned explorer, dying of heart failure on June 5th. The expedition can hardly expect to escape with this one fatality Colonel Bury states that the vegetation and colored butterflies are wonderful The party received the full benefit of the monsoon A couple of minutes of the huge deluge was sufficient to penetrate any waterproof coverings. The mules which were depended upon for transport home collapsed miserably and horses had to be substituted

Have You Claustrophobia?—If you hate the subway you may not know you are ill but you probably are—of claustrophobia which is a psychological disease involving a fear of closed places. Of course the subway is only one of the places where this disease "discovered" by nerve specialists is manifested, the theater and the church are also predisposing causes. Other unnatural fears which are sometimes good grist to the aforesaid specialists are the fear of high places, fear of open spaces, fear of uncleanliness and fear of having forgotten something. Sometimes a person has all these and still survives to a ripe old age without the alienist or the asylum, so such fears through disagreeable environments are not very serious as they seldom unhinge the mind

Steam Pressure Cookers in Ecuador.—A correspondent writes us that the Jivaru Indians have a steam "pressure cooker" all their own A nearthenware jug or pot, small at the bottom, bellying out at the middle to about 15 inches, and then into a narrow neck, ends in a lipped mouth. A grid or false bottom of split bamboo is built about three inches from the bottom of the pot, the space between is filled with water, the food—meats or vegetables or both—is then placed on this grid and the top of the pot is covered with several large, palm leaves, criss-crossed and tied down with vines. The pot is then placed upon the fire and the food is thoroughly cooked in a very short time This "latest" method has probably been used by the Jivaru Indians for centuries, and our correspondent says that he has enjoyed many a monkey and parrot cooked by this method.

Industrial Efficiency

Degumming of Ramie.—In a recent issue of the *Indian Textile Journal* the invention of a new process for degumming ramie fiber is reported The process is past the experimental stage, as 1,000 pounds of ramie can be treated at one operation, producing from all qualities of grass a strong, durable and thoroughly degummed fiber, which has been satisfactorily dyed and spun. Ramie is reputed to be the strongest of all textile fibers and especially suited for all purposes demanding endurance of hard work, such as sail canvas, fishing lines and nets, boot laces, and shikari cloth. The ramie plant grows wild in most parts of India

Oil-Bearing Nuts.—The royal palm tree, especially the varieties bearing corozo and cohune nuts, grows extensively in the coastal region of Guatemala, and although as yet little industrial use has been made of these oil-bearing nuts, they might become the source of an important vegetable oil industry, not only because of the great quantity of nuts in the country, but also because of the fact that the oil contents of the Guatemalan kernels is understood to be 65 per cent, in comparison with 42 per cent, for African nuts The yield of kernels per ton of nuts in Guatemala is about 18 per cent

The Graphite Industry.—In the island of Ceylon graphite is found in greater abundance than in any similar sized area in the world The soil and rocks of Ceylon are almost everywhere impregnated with graphite, so that it may be seen covering the surface in the drains after a rain The supply is practically inexhaustible The peculiarity of Ceylon graphite is its remarkable purity Another source of graphite is Chosen, the graphite found there being classified as scaly, fibrous, foliated and earthy, the first two classifications containing over 90 per cent carbon In China, graphite is found in several localities.

Labor-Saving Machines for Philippine Hemp. — Many hemp-stripping machines of a simple type are in operation on the hemp plantations of Mindanao, and two 8-horsepower oil engines connected with sets of four stripping machines each have recently been installed in that region The machines pull the hemp over a knife in much the same manner that it is cleaned by hand They are comparatively inexpensive and are operated by one man With the aid of one of these machines one worker can strip a picul (about 140 pounds) of fiber in a day, which would be a large amount of work for one week if done by hand

More Heat from Locomotive Ashes.—Owing to the large amount of unburnt coal in locomotive ashes and smoke-box cinders, they have comparatively good calorific value and, if collected, can be burnt in stationary boilers for the generation of electricity, according to *The Technical Review* For the clearing of ashes out of the smoke-box, a vacuum pump is most useful, and for the clearing away of the ash and clinker which have been dumped in the ash pit, a bucket conveyor is used This conveyor, in the case of a German installation, is driven by an electric motor, where the conservation of fuel is being practiced on an extensive scale

French Steel Companies in Combine.—Through the office of our commercial attache at Paris it is learned that three of the largest steel corporations in France have recently combined The principal company of the new combine is the Societe Anonyme des Forges et Acieries du Nord et de l'Est, the capital of which is to be increased from 40,000,000 francs to 80,000,000 francs, and to absorb the holdings of two other companies It is stated that the new company will control an ore domain with equipment for an annual production of 4,000 000 tons, and also six large French coal companies and important coal deposits in England, as well as coke, cement, and building material companies, rolling mills, foundries and casting plants.

New Director of Bureau of Foreign and Domestic Commerce.—Julius Klein, who was appointed by the President as Director of the Bureau of Foreign and Domestic Commerce to fill the position made vacant some time ago by the resignation of R. S MacElwee, has assumed his duties. Dr Klein first came to the bureau in September, 1917, as chief of the Latin-American Division. He remained in that capacity until May, 1919, when he was made commercial attache to the Department at Buenos Aires, Argentina He resigned from his position in October, 1920 Dr Klein has specialized in Latin-American economics, trade, and politics, and since his resignation as commercial attache he has held the chair of assistant professor of Latin-American history and economics at Harvard University He comes from this position to the Bureau.

Pulling the Mississippi's Teeth

What Is Being Done by Way of Making Our Longest River Navigable

By George H. Dacy

OUR Father of Waters, the peaceful, placid, tortuous Mississippi, which runs amuck and bursts its bounds only once in a dog's age, is unique as a channel of inland barter and commerce. Its shipping potentialities and prospects were long neglected during the period when rail traffic was in its 'teens. For this reason and that reason, because of disinterest of those who would be benefited most by its development or because Congress was always too busy with other affairs to bother much about the crooked, illy navigable river, the Mississippi for scores of years pursued her catch-as-catch-can course, unharassed and unsung. River packets and freighters, scows and bumboats, dories and derelicts plied their difficult and hazardous ways between St. Louis and New Orleans. Year after year, the stationary volume of traffic and unchanging type of boat bore witness to our lack of appreciation of one of the best inland waterways with which any country ever was blessed. Participation in the international war changed the focus of the glass through which we had missed seeing the possibilities of the Mississippi River. The Mississippi at last came into her own and a belated development was instituted. Much has been done toward bettering shipping facilities and shipping conditions; prospects are that much more will be done in the future. The Father of Waters finally will occupy the prominent position in our interstate freight exchange which its natural advantages justify.

In January, 1918, the Director-General of the Railroads appointed a committee to study the possibilities of utilizing our inland, canal and coastwise waterways for transportation purposes. Six months later, an appropriation of approximately $8,000,000 was authorized by Uncle Sam for the construction of a federal fleet of barges to operate on the lower Mississippi. Twenty steel, flat-deck barges of the U. S. Engineers, capable of carrying 450 tons of freight apiece, as well as eight barges ranging in tonnage capacity from 400 to 1000 tons, were immediately chartered for freighting service. Simultaneously, plans were devised and work begun on the construction of a fleet of new, auxiliary barges. These activities have continued even after the cessation of warfare with the result that right now the Federal barge line which operates out of St. Louis has in service six old type tow boats, one new self type propeller tow boat (5 similar boats are under construction), 40 two-thousand ton steel barges, and 4 smaller steel barges which range in size from 500 to 1000 tons.

With the remarkable improvement in the shipping facilities along the lower Mississippi, the importance of maintaining the channel navigable and free of all obstructions has been intensified. This brings into the limelight the novel snag boats, the most extraordinary vessels which Uncle Sam supports—either in or outside of his Navy. The Mississippi carves out and carries away huge fragments of the banks that fringe her crooked course. Untold miles of these consist of farm timberlands and forests. As a result, she often dislodges and steals great strips of land containing large trees. These impediments she whips away only to have them sink and settle, ultimately, in the sand and mud of the open channel—there to effect evil and ruin unless discovered and eliminated by Uncle Sam's water sleuths. The general term 'snag' may signify anything from a small tree of half a ton or so to an entanglement of large fellows weighing many tons. Whatever their size they must come out if they are in the channel.

Away back in the days of Mark Twain, Government snag boats were operated on the Mississippi, although the obstructions were not removed as scientifically and efficiently in that era as they are in the present. Rivermen and navigation experts say that this service will have to be continued as long as the river exists and is utilized for transportation purposes. The Government now maintains three large snag boats on the Mississippi, two on the lower river which police the beat that extends from St. Louis to New Orleans, and one on the upper river, north of St. Louis. One other large snag boat is operated on the Ohio River while smaller vessels patrol such tributaries as the Arkansas and Missouri.

For the last 33 years the Government has annually appropriated $100,000 for snag work on the lower Mississippi. Two snag boats, the "Horatio G. Wright" and the "John N. McComb" are specially designed and equipped for this service. The peak of their activities comes during the summer months from July on, when the river is low and the quest for snags is most fruitful-ly rewarded. The usual plan is to maintain one of these boats at the southern extremity of the Mississippi and the other in the northern districts adjacent to St. Louis, as bases. This means that the boats can speed to localities where snags are reported as dangerous in their respective zones without needless overlapping travel. In one trip of 1100 miles last summer, the "Horatio G. Wright" sighted, pulled and destroyed over 600 gigantic snags, the average weight being more than 40 tons while the heaviest topped 175 tons. The next trip over its beat, this police boat destroyed only 200 snags. River conditions, the water level, the season of year and various other factors influence the prevalence and appearance of snags, so that it is impossible to plan a definite and accurate campaign and to estimate the work and the number of snags which will be spotted and lifted in a certain season.

The maximum speed of the snag boats, each of which is about 190 feet long and 95 feet wide and carries a crew of 45 men, is approximately 8½ miles an hour in still water. Ordinarily, the snags point down-stream and often are buried anywhere from 10 to 40 feet deep in the mud, the tendency for trees which are carried away in the shore-undermining activities of the turbulent waters being to right themselves and to settle in the sand in an erect, upstanding position. The snags are so securely anchored that they rip holes in the bottoms of vessels which collide with them. Waterlogged, anchored snags effect the greatest damage, river pilots have had to contend with them ever since navigation between New Orleans and St. Louis was begun. The position of the snag in the water is indicated by the V-shaped break which it causes in the surface of the river. A snag submerged even as deep as 30 or 40 feet causes a boil in the overhead surface water which is easily recognizable by the lookouts on the snag boats. The Federal snag boats are of the double-bowed, catamaran type with a steel butting beam 15 feet long and 10 feet wide connecting the bows. When a snag is sighted, the boat is maneuvered close to the point where the V-shaped break appears on the water surface so that the crew can lower a huge sweep chain operated by means of 4 engine-driven capstans, each of which can exert a pull of 35 tons. The chain finally will engage the snag and raise its free end out of the water. Windlass chains are then used to haul the snag on to the beam, a special engine being used to run an enormous drum which releases or winds up a huge sansom chain that can resist a strain of 75 tons. The individual links in this chain weigh 27.5 pounds and are made out of round iron 2½ inches in diameter.

In case difficulty is experienced in loosening the snag, the boat resorts to butting tactics. It backs away from the obstruction about 60 feet and then under full steam slides at the snag and smashes into it with its steel butting beam and 800 tons of total weight. This method of attack is repeated until the snag gives way. The shock of the concussion is so violent that frequently all the members of the crew are sprawled headlong on the deck and the firedoors under the boilers are knocked open. When the snag is freed sufficiently, the windlass chains are used to haul it up over the beam where it is placed in such a fashion that engine-driven saws may be used to cut the tree or obstruction up into sections about 20 to 25 feet long. These logs are then cast overboard and generally are salvaged and sold by squatters who live along the river banks or by parties in gasoline launches who follow the snag boats and make a business of gathering the drift logs and hauling them to sawmills and selling them. Sometimes, these loggers of the river realize $100 or $150 from a single day's work in salvaging stray logs which emanate from the activities of the Government snag boats. Snags which will not float after being dismembered are hauled on the snag boats to deep sections of the river and there dumped overboard. They sink in the sand and henceforward do no more damage.

The heavy chain is used to haul the heavy snags over the roller. Each link of this chain weighs 27.5 pounds and is of 2½-inch round iron

Considerable danger is associated with the raising and destroying of the river snags, but despite the hazards, men like to work on the Government boats as there is a certain romance associated with this pioneering work which appeals to the adventurous natures of the rivermen. During the last score of years, four men have been killed and 60 injured on the snag boats as a result of slipping or breaking of chains or the sudden collapse of snags when they were pulled from their mud beds. In the case of wrecks which have sunk to the bottom and are dangerous to traffic, experienced divers are employed to salvage the valuable machinery and then the heavy drag chain is used to smash them into small timber. Sometimes accidents ensue here.

These unusual craft of Uncle Sam are also employed in raising wrecks which are still serviceable. A noteworthy accomplishment of this description was the lifting of the wrecked packet steamer "John Simonds," sunk during the Civil War and raised to the surface a half century later. The machinery in this boat was still in excellent condition despite its long sojourn in the water.

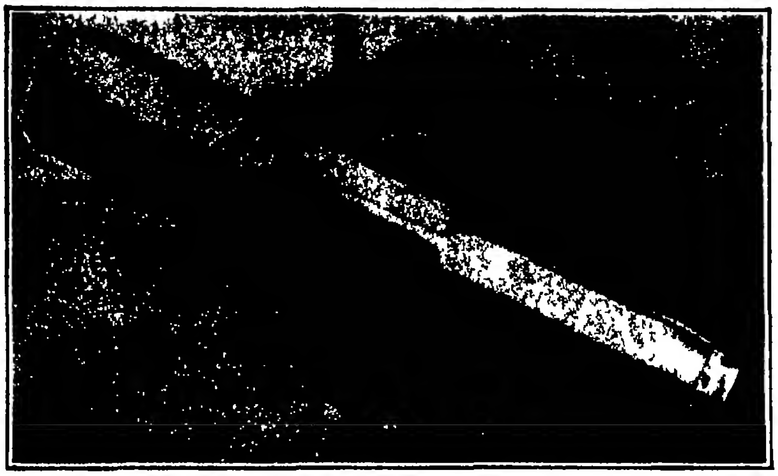
(Continued on page 79)

The Temple Driver—a Powder Gun Which Has No Recoil, Concussion or Flash

OCCASIONALLY a useful invention makes its appearance which is so entirely novel in its operation and practical applications that it is difficult to find a properly descriptive name. In this class is the subject of the present illustrations and story. It is a gun, for it derives its extraordinary power from the combustion of gun powder, but unlike the gun, it finds its immediate and largest field of usefulness in the constructive arts. It takes its name from Mr. Robert Temple, an engineer who received the decoration of "Order of the British Empire" for his inventions and service in the World War.

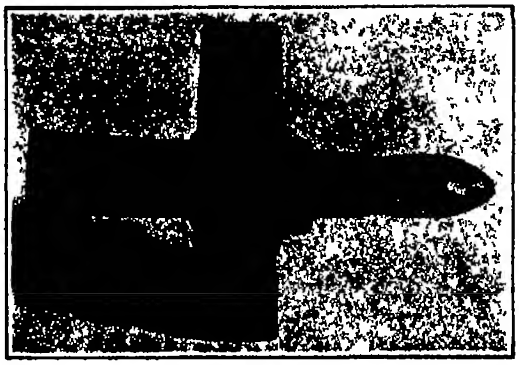
For the reason that this device is under consideration by the Naval and Military Authorities, its construction and the principles on which it operates cannot be disclosed at the present time, although we hope to give a fuller description in a later date. We have seen and handled the gun in its disassembled condition, and it is sufficient to state, just now, that it involves an entirely new principle in ballastics or, rather, we should say that it consists of a novel and very ingenious application of old and well understood principles. For the present we publish the accompanying photographs showing the tool and some of the work done by it in a demonstration by Dr. Miller Reese Hutchison, in this city.

The Temple Driver is a small portable tool of about the size and half the weight of a pneumatic riveter. The driver, or gun (for such it is), is shown held in a person's hand. It is about an inch and a half in diameter and ten inches in length. In the demonstration we witnessed, it shot a projectile of case-hardened machine-steel into a piece of boiler plate five-eighths of an inch in thickness. This was one of a large number of bullets which had already been shot into the same plate, and the powder charge and the various internal elements of the gun had been so adjusted, that all the bullets came to rest with their center of length lying in the center of the plate and equal portions projecting on either side. The after half of the bullet is threaded so as to enable a nut or a threaded eyebolt, suitable for attaching a lifting hook, to be screwed home after the bullet has penetrated.



The gun proper containing projectile, powder and firing mechanism

The novelty of the gun consists of course in its short length and small weight in proportion to the power developed and also in the fact that there is no recoil, no escape of gases, no report, and no flash. The means by which these last three results are obtained cannot at present be disclosed and it must suffice to say that they are simple, practical and based upon the laws of the expansion of gases and of inertia. In firing the gun in the case of the test referred to and herein illustrated, the muzzle is placed against the plate at the point to be perforated, and a pressure upon the handle of the sleeve in which the gun slides serves to detonate the powder charge.

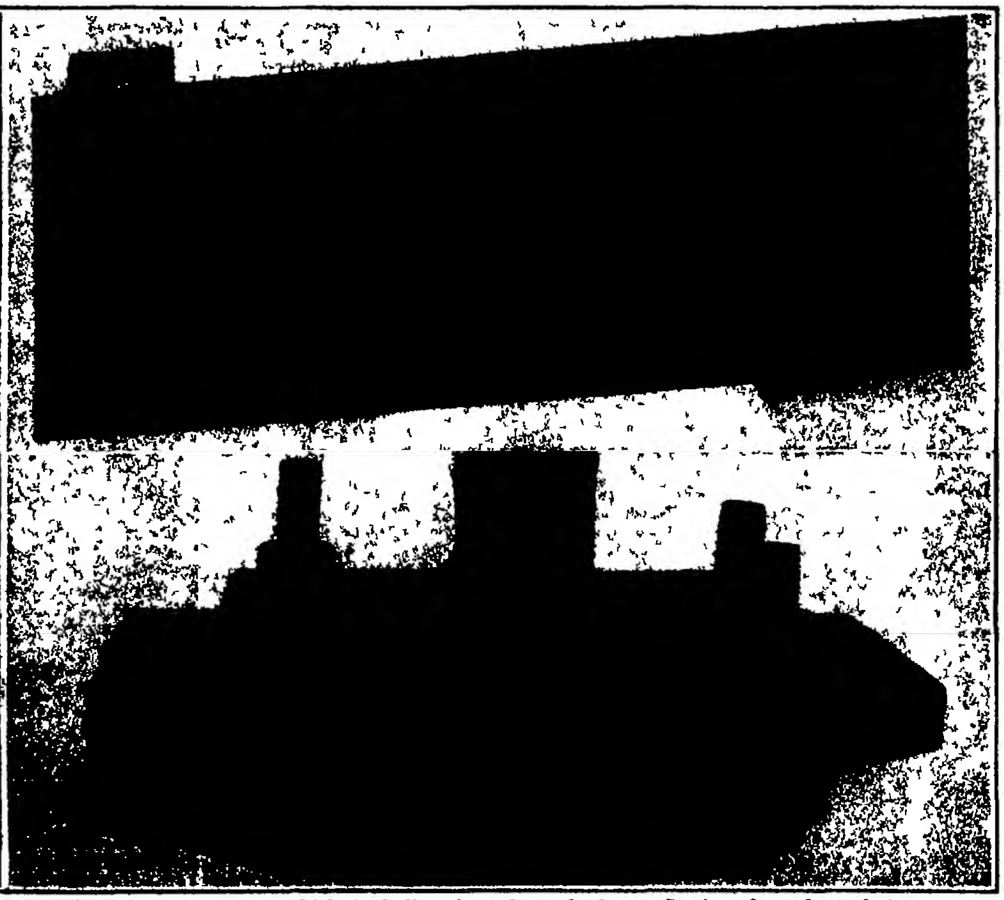


Projectile in form of twist drill cut a spiral path through steel plate

A big field of usefulness for this machine lies in deep sea and salvage work. Thus, the well known deep sea diver, Crilley, shot a one-half inch steel stud into a five-eighths inch boiler plate at a depth of 36 feet below the East River, New York. The plate was then put under a testing machine in the laboratory of the New York Navy Yard by Navy officials who wished to determine the pressure required to force the bolt out, and it was found that a pressure in excess of seven tons applied at the pointed end of the stud was necessary.

Another significant test was made by the Merritt Chapman Derrick and Wrecking Company's diver who, under water, attached a lifting plate to a heavy dredge bucket by shooting four studs through the lifting plate and the bucket. On hoisting, the bucket was lifted by these studs. Then, in order to subject them to a heavier strain, the bucket was allowed to fall a certain distance, when its movement was arrested suddenly by checking the lifting gear. The attachment held fast.

The application of this contrivance in the arts and industries may be various, but obviously it will have immediate use for the lifting of sunken ships and for the placing of patches over perforations in the hulls of disabled vessels. The patch plate would be drilled with the number of holes desired, and the inner face of the holes would be countersunk to allow space for the metal of the plate that is to be perforated to flow back in the direction from which the stud or bullet enters, for there is an extrusion of metal on both sides of the plate around the stud. When the patch plate has been adjusted in place, the diver fires a stud through each hole in the patch, thereby riveting, or clinching it in place. It is evident that the lifting power will be limited only to the number of studs employed.



1. The gun is mounted and handled like a pneumatic riveter. 2. Back of boiler plate into which 26 bullets have been fired. 3. Section through angle-irons and bullet studs, used to lift a sunken boiler

Molybdenum Steel in the Motor Car

Reducing Weight in High-Power Cars by the Use of New Steel Alloys

BROADLY speaking, it may be said that the effort of the designer of the modern motor car is directed mainly to two objects, an increase of the power and a decrease of the weight, for it is certain that in spite of all that has been said about the smooth riding of heavy cars, no one wishes to carry unnecessary dead weight around with him, and everyone wishes to have a reserve of power in hand upon which he can call in emergencies. Increase in power has been gained by careful design, in which improvement has been carried into the smallest details, and also, and more particularly, by a great increase in the speed of revolution. On the other hand, decrease in the weight of a car has been secured by a great refinement in the parts, following upon a careful analysis of the stresses to which each member of the car is subjected, and also, and more particularly, by the use of the wonderful alloy steels which developments in the metallurgy of steel have placed at the disposal of the automobile builder.

What metallurgy has done for the automobile in recent years would make an interesting story in itself. From the ordinary commercial steels of which the early motor cars were built, we have progressed through the special carbon steels and the various alloys, up through the vanadium steels to the latest and most remarkable of them all, molybdenum steel — a material of construction which was practically unknown in this country prior to the war, and only now is coming into its own.

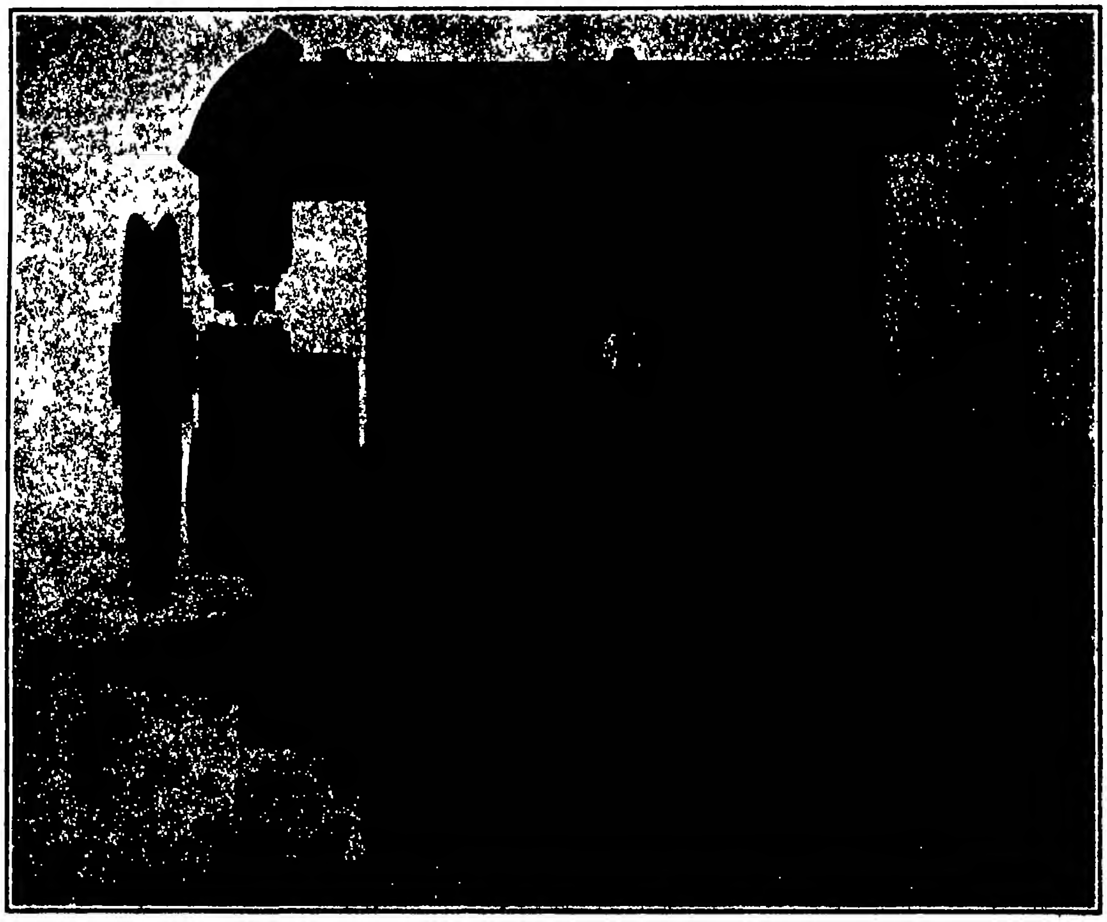
The use of molybdenum steel in motors in this country is to be credited chiefly to Mr C. Harold Wills, who for about twenty years was associated with the Ford factories, and more than anyone else was responsible for that remarkable combination of light weight, power and durability which is to be found in the Ford car. To him also is to be credited the special machinery and equipment and the quantity - production methods, which brought the output of the Ford factories up to a total of over 8,000 cars a day.

The commercial introduction of molybdenum steel in the United States was brought about by the demand for use in the Liberty motor, of a steel of super-excellence, and, in response, Mr Wills turned his attention to the new alloy, molybdenum steel, which he used successfully for the crank shafts. The service secured from these crank shafts and from other parts of the motor for which molybdenum steel was used was eminently satisfactory—so much so that Mr Wills decided to devote himself to the development of an automobile, of light weight and high power in which this material should be used for all those parts of the machine that are subjected to great stress. To this end he built the new plant and town of Marysville which formed the subject of our article in the issue of the SCIENTIFIC AMERICAN of March, 12, 1921.

Advantages of Molybdenum Steel

There is probably no mechanism in the world today that is subjected to such hard usage as the working parts of an automobile. Not only are the stresses dynamic, but they are subject to reversal, and because of the insistent demand that the weight shall be kept down, it is necessary to reduce the size of the parts to a point where the stresses, at times, must necessarily approach the limits of elastic strength. The steel employed must have the combined qualities of hardness, toughness, resiliency, and ability to withstand sudden and great reversals of stress and a continued succession of shocks of the heaviest character. The merit of molybdenum for automobile construction lies in the fact that it meets all these heavy demands with such reliability and staying power that it is possible to reduce the sectional weight of the parts to a point which no manufacturer would care to approach with any other known steel. This will be understood when we state that, whereas it would have to be a very good carbon steel that a manufacturer would care to submit to a unit stress of 70,000 pounds to the square inch, the new carbon-molybdenum-nickel steel can carry a unit stress of 150,000 pounds with safety. Moreover, the molybdenum steel would be the tougher of the two. Naturally, there are variations from the above-quoted figure, for in parts of the car that are subjected to great fatigue, such as the connecting rods, the unit stress drops to 135,000 pounds to the square inch. On the other hand, in the gears it is possible to use a unit tensile stress running as high as 335,000 pounds.

The advantages of using a small percentage, from 0 per cent to slightly over one per cent, of molybdenum in steel, are stated by Mr Wills as follows: First, in forge practice, the molybdenum has no tendency to segregate, and rather tends to prevent segregation of the other ingredients of the molten steel; second, the range of temperature for heat treatment is greatly increased, and instead of being confined within ten to twenty degrees Fahrenheit, as is usual in present commercial alloy steels, the range is increased to about 200 degrees. To put it another way, molybdenum prevents detrimental structural and chemical changes from taking place until the temperature rises several hundred degrees above the point of recalescence. Consequently, elaborate furnace-regulating equipment is eliminated and losses in manufacture and in service are reduced to a minimum. Moreover the use of molybdenum makes it possible to draw at a much higher temperature than could be used in other alloys. Another great advantage is the excellent machining characteristics of the steel, which may be machined to finished size without suffering any distortion. As to its physical properties, the tensile strength and the elastic limit are greatly increased, and a maximum elongation is obtained. The steel has a very high resistance to impact shock and to alternating stresses, which it will withstand without crystallization. Another advantage is that, due to the excellent action of the steel under case-hardening processes, it is possible to secure a material with a tough center and a hard wearing surface, such as is required in gears, cams, camshafts, roller bearings, valve pins and other automobile parts. In case hardening, Mr Wills finds that molybdenum secures a deeper penetration with a heavy carbon content at the surface.



Section through one block of cylinders of the new molybdenum-steel motor car

Reduction in Weight

It will be understood that in designing the working parts of a car upon the basis of a unit stress of from 150,000 to over 300,000 pounds to the square inch, it has become possible to make a very considerable reduction of weight in proportion to the horsepower developed, and although the Wills type of motor car has developed a brake horsepower of 65 to 70, the weight of the car runs from 3,000 to 3,200 pounds, according to the equipment. In the load test the car developed from 65 to 70 horsepower at 2,700 revolutions per minute.

The Engine

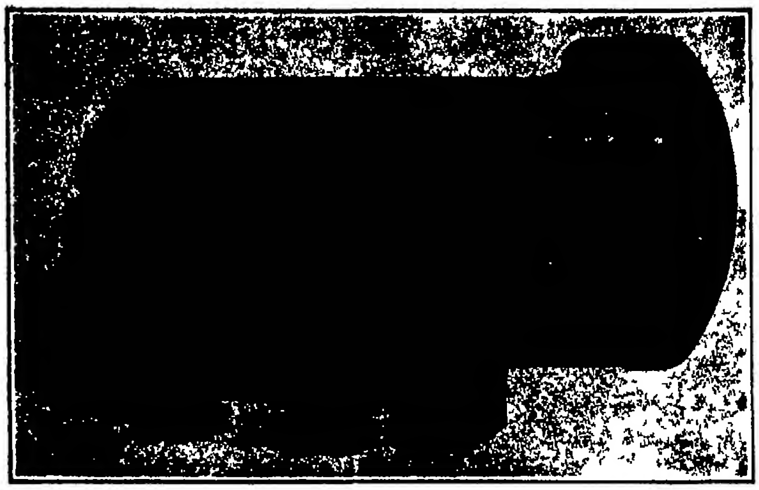
The engine, which is of the 8-cylinder V-type, embodies features both of automobile and airplane engine practice. The cylinders are set at a 60-degree angle with overhead valves and camshafts, and gear drive, the carburetor being carried above and between the cylinders. The stroke is 4 inches, and the bore 3¼ inches, giving a total displacement of 265 cubic inches, or 3.8 cubic inches per horsepower based on a maximum output of 70 horsepower. This is a remarkable showing, being exceeded only by certain of the racing cars of which the most notable case is the Begatte, with 2.5 cubic inches per horsepower. Compared with commercial cars, we find that one of the best known of the high power cars has 5.5 cubic inches per horsepower, another 6 cubic inches. In the Ford is reached the high figure of 8 cubic inches per horsepower.

The valves are seated in the cylinder head. The intake valves are made of chrome molybdenum, and the exhaust valves and valve stems, T, are built up of various metals, with a view to eliminating changes of length, due to expansion and contraction, and securing good wearing quality. The stem, T, is of 30 per cent nickel and steel, an alloy which shows a minimum contraction and expansion under variations of temperature. The face, V, of the valve where it seats against the cylinder is of 40 per cent chrome steel, and in the head of the valve stem there is welded a button of the same hard, 14 per cent chrome steel. The cylinders are of special cast iron, cast in blocks of four, and the pistons are of a close-grained cast iron, with a flat top, polished to prevent carbon deposit. The camshafts connecting rods, front axle, transmission gears

and shafts, springs and wheels are all of molybdenum steel.

Eliminating Noise

Particular attention has been paid to the elimination of noise in the running parts of the car—a prime consideration at all times—and in securing this result some very ingenious work has been done. Take, for instance, the camshaft. As we all know, the cams are so distributed circumferentially upon the shaft that the latter is subjected to intermittent stresses as each cam comes into operation. At the lower speeds, this has a vibratory effect upon the shaft, with the result that a singing note or humming sound is given out by the metal, which disappears only when the revolutions have reached a point at which the applications of stress to the camshaft occur at such high frequency that they have the effect of a continuous torque. When this point is reached the objectionable hum disappears.

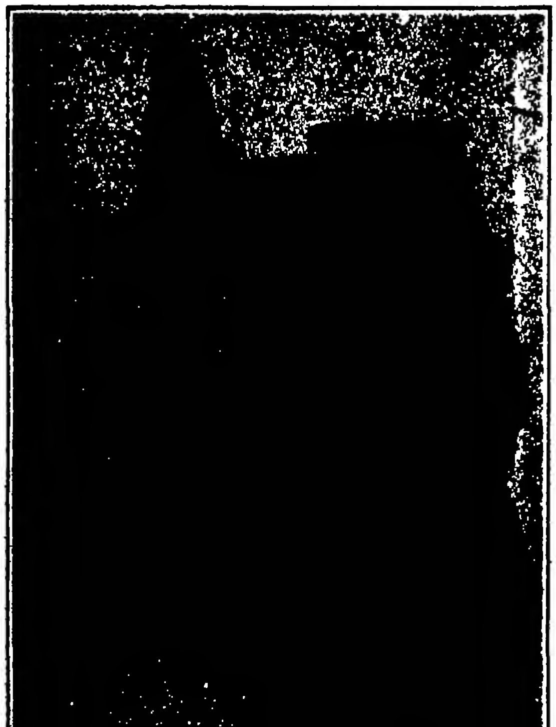


Detailed view of after end of camshaft, showing noise-deadening devices

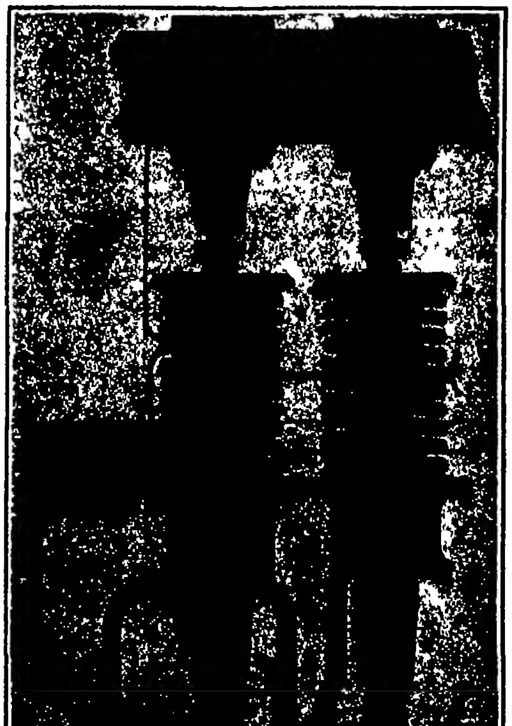
To counteract this, it was determined to apply a continuous braking force upon the camshaft, which should continue until the critical speed was reached at which the hum of the shafts disappears. Accordingly, the rear end of the camshaft was extended and provided with a fixed cone, H, a sliding cone, J, and an annular double cone, I, designed to engage H and J Normally, the faces of the three cones are maintained in contact by the action of a coiled spring, K, mounted upon the shaft and secured thereto. It should be explained that the ring or double cone, I, is so keyed to the casing as to allow of longitudinal movement.

In operation, the pressure of the spring, K, keeps the cones and the ring in such frictional contact as to produce a braking effect upon the camshaft But as the speed increases, the centrifugal effect forces the lubricating oil to work its way out from the space, X, and between the faces of the cones and the ring, I, until the ring is running on a film of oil and the frictional retardation of the shaft is eliminated The coil spring is adjusted so that this release will take place as soon as the critical speed has been passed This ingenious device has proved to be very efficient

Another part of the machine from which noise has been successfully eliminated is the gears The gear wheels have their own metallic note, and the problem was to find some means of damping out the vibrations which result from the successive contacts of the teeth. This has been done in the Wills motor car by forming the periphery of the gears in which the teeth are cut, in three parts and reassembling them with sheets of paper, M, or other noise-deadening fabric, interposed between the parts. The teeth are formed of two rings, L and L', L-shaped in section, which are placed back to back and held in the periphery of the wheels by means of a clamping ring, S, and a series of rivets, N, the strips of paper fabric being inserted in the three places indicated in our drawing.



This shows fan release and noise-deadening fabric in the gears



Exhaust valve stems of non-expanding 39 per cent nickel steel

Some Other Details

Among other details which are shown in our drawings is the clutch release for the fan. The fan reaches its highest effect at a certain speed of revolution, above which it simply consumes the horsepower of the engine, with no useful return. Hence, a clutch release of the cone type is used. The fan A is drawn into frictional contact with the cone C on the shaft B by the action of a coil spring F. When the speed of the fan A reaches the point of highest efficiency, the reaction of the air against the blades becomes stronger than the tension of the spring F, and release takes place. This point of higher efficiency is shown by laboratory tests to be reached at a speed of 2700 revolutions per minute. At higher speeds the fan causes a useless consumption of horsepower

We direct attention also to the clutch, which is of the multiple dry-disk, central spring type, with six driving and six driven disks. In order to secure application of the clutch with a cushioning effect and a gradual take-hold, without shocks or jerking effects on the car, use is made of a lining of asbestos cord, which is woven into the driving disk in the manner shown in our drawings. This lining cannot be burned and has an unusually long life

The lubrication is of the forced-feed type with a pressure regulating device, the crank, cam, and camshafts being drilled axially to provide lubricating channels. Particular attention has been paid to the crank pins, where the oil passages are drilled tangentially to the axial hole, and the oil is forced by centrifugal action into cup-shaped channel ways, formed at the periphery of the crank pin to assist in the free distribution of the oil Finally, it should be noted that molybdenum steel has been used in the wheels, which are of the disk type and designed specially for this car Here, also, there is a gain in strength, with a marked saving in weight.

Learning Things About Cider

WE never knew so many things about apple cider as we are suddenly learning in this new prohibition age Cider is an old fashioned farm beverage It was typically made, in the old days, in water-power mills. The cider-mill was a local mill to which farmers hauled cider apples—often culls and natural fruit—in dump-carts. The cider barrel was a hogshead with a great wooden bung, around which a piece of burlap was often wrapped Farmers used to say that Russet cider—meaning cider from Russet apples—was the best there was.

But what old timers knew about apple cider was as nothing to the kind of knowledge which the nation is now rapidly acquiring The consumer in large cities is learning that apple juice is a wonderful beverage, and demanding it, and overnight a manufacturing industry of large proportions has developed The seat of twentieth century cider-making is not, as it was twenty five years ago, the country water power mill It is a city industrial plant, to which apples for cider are often shipped long distances.

This city plant makes cider from time to time through the winter, drawing on stored apples and supplying dealers with a constant fresh supply In the old time cider mill, cider was usually only made for a short period in the fall Sweet cider in the country never has been obtainable for much more than a few weeks after apple harvest Then the cider has grown hard, it's on its way to vinegar So there is much feverish experimenting with processes to keep cider sweet. The value of such processes, in this prohibition age when new beverage habits are being formed, is obvious.

A few years ago cider apples were always obtainable for a few cents a bushel. But when, in early winter this year producers on whose hands apples had become accidentally frozen, turned them into cider, the value of the liquid obtained from a barrel of apples was, in some instances, $7

As only would be expected, matters connected with apple cider are "getting into court." In British Columbia, adjoining the State of Washington and equally dry, a cooperative farmers concern was accused by the provincial government of supplying a dealer with cider containing 10 per cent alcohol Producing evidence that as shipped the particular consignment contained about 2 per cent, and suggesting that afterward somebody had put "something" into the cider, the growers called as an expert witness the manager of a vinegar factory

This expert testified that it was chemically impossible for the cider to have developed the alcoholic content stated, without tampering He said that the sugar content of Okanagan Valley apples, varying with the season and the particular variety of apple, ran from 7 to 14 per cent The alcoholic properties of cider, he explained, depended entirely on the sugar content, the heaviest alcoholic proportion possible being 50 per cent of the sugar The maximum development of alcohol in pure cider of Okanagan apples was therefore 7 per cent, so the growers were found innocent

Cider is a coming beverage Hand or power mills for making it at home are being extensively bought There is a disposition in some quarters to discard the old fashioned name, cider, and adopt another The name cider is shrouded in a definite, peculiar atmosphere all its own—an atmosphere which some fastidious ones are not taken with.

Succeeding in Architecture

Opportunities Awaiting the Young Man in This Field, Especially in the Immediate Future

By Raymond Francis Yates

THE author spent several very pleasant hours with Mr William Crocker, Editor of the *American Architect*, in gathering material for this article Mr Crocker is an energetic man brimming over with enthusiasm and love for the field he is working in In giving the advice contained in the following lines, he spoke as if he were giving counsel to his own son, and the writer heartily wishes that every young man who plans to study architecture could spend a few precious minutes with him The warmness, sincerity and honest truth of his words are inspiring.

Many people are inclined to look upon an architect as a man with great artistic ability In fact an artist He should wear a Windsor tie, a VanDyke beard and his hair must be long and not too carefully combed He should be very temperamental, work in a studio, not an office, and all the prerogatives of the Greenwich Village 'artist should be his Certain men who stand high in the architectural field believe this and preach it Mr Crocker has an honest argument for those who are 'responsible for that type of man who regards the esthetics of his profession of more importance than its practical aspects ' He rightfully asks "Have we developed designers to a greater extent than architects?"

An architect is by no means a mere designer of buildings Our college courses in the past have tended to make him such When the United States entered the war, the architects were not only amazed but chagrined when they were put under the direction of engineers It was the natural outcome of the course they followed Many of them were 90 per cent designers and 10 per cent engineers, when they should have been 10 per cent designers and 90 per cent engineers

A real architect must not only be a designer of buildings but also a practical engineer entirely capable of carrying out and overseeing the construction of the buildings he designs whether they be factories, libraries or homes Since the war the colleges of this country have at last come to realize this fact and rapid changes are being made in the curriculum of architecture These changes should have been made years ago but it took the World War to bring about this realization

The architects who took part in the war were really put where they belonged —under the direction of practical engineers. Many of them were not capable of overseeing any real engineering work with any degree of success An architect should be a building engineer capable of directing constructional engineers and other engineers who take part in the erection of buildings

The field of architecture is by no means over crowded nor does it offer large incomes to other than the real leaders in the field Statistics show that but 4 per cent of the architects of this country paid an income tax last year This is an amazing statement, but nevertheless true Probably the 4 per cent who did pay an income tax paid it on rather large incomes There does not seem to be any definite limit of salary for those who have struggled to the upper heights of the profession Men like Cass Gilbert, who designed the Woolworth Building enjoy incomes obtained by few men in this country The field really does recognize men with ability and offers tremendous opportunities to those who step out from the crowd

A great number of architects go into business for themselves Some start in small towns, others start in large towns In any event they must be active in civic life as a matter of pure business The architect in the small town should be active socially and take part in all civic programs—he must work himself into the life of the community His first few years of business will be a hard struggle to establish himself If he is fortunate enough, or has business foresight enough to locate in a thriving community he will progress rapidly Growing communities can increase in size no faster than the architect can design buildings and oversee their construction If a young man, after leaving college is unfortunate enough to pick a bad location real success will probably never smile upon him if he remains in business for himself

Most of the colleges in this country have courses in architecture A full four year course is required to produce a thoroughly trained man Men have been known to struggle along outside of college and train themselves in the fundamentals of this work College is, of course, never necessary to the man with the real burning desire to succeed in any field

After leaving college a young man cannot expect to derive a large income from the practice of his profession as an architect. If he locates with a company, a salary of $2,000 a year to start with would be considered good If he goes into business for himself he may make $1,000 or he may make $5,000 This depends entirely upon his ability as a business man and upon the development of the community in which he locates. Those who make $5,000 in their first year of business are indeed fortunate

There is nothing uncertain about the future of architectural science It is one of those professions that will survive as long as civilization lasts Building is one of the primary human occupations There will be changes in the architectural field no doubt, but they will not affect it greatly The greatest change that the field has had for many years is taking place at the present time This change is by no means harmful. It is just the reverse It will tend to make a more useful and capable individual out of the man who decides upon casting his lot in this work

To be a good architect a man must first be sure that this is the field in which he should be working Aside from this he should have good sound business training he should be practical as well as artistic He should be a 'good mixer" To be this he must have a friendly disposition

An architect must be able to handle and direct men This is really one of the most important parts of his work and the architect of the future is going to be called upon more and more to direct a large corps of engineers working under him The architect of the future will not be a mere designer of buildings, he will be the master builder He must be a man of force, character and ideas. He must take his stand with other engineers The day of the artistic prude who believes that it is his lot to design gilded cages for the wealthy to live in, or beautiful churches that will suit his artistic temperament, is gone

An architect worthy of the name like a man engaged in any other profession, should have some particular ambition in life For instance the writer once knew a young architect who had an ambition to design the most perfect tenement house ever conceived It was his idea to perfect the design of a house that would be convenient light airy, sanitary and fire-proof This was a very humanitarian idea and if this young man ever succeeds he will have done a great service to the world The author also knew another young architect who believed that he could render great service by setting about to develop still better hospitals than exist today He made a special study of the problem and it was his desire to gain recognition in this particular branch of architecture There are a thousand and one ambitions that an architect could have and they would all tend to urge him on to a higher position in his profession. The young man who enters any engineering or technical field without an ambition to do something special in that field will wander aimlessly on never realizing anything of special note. It is the man with something to strive for who pokes his head above the crowd and makes a name for himself

ARCHITECTURE as a profession is generally misunderstood by the laity It seems, so we are told by Mr Yates in the accompanying article of his series on the opportunities in various lines of endeavor, that most people have come to look upon the architect as a man with great artistic ability, little engineering training, and still less business ability The architect, in the popular mind, is often looked upon as a Bohemian, with all that designation entails Fortunately, however, Mr Yates has uncovered facts that prove the architect to be quite the antithesis of the proverbial artist, the architect, as he reveals him to us, is an engineer with a fine sense of art, a leader of men who can plan and direct big undertakings, and a business man and man about town if he would be successful—THE EDITOR.

The United States is three years behind in its building program During the war only that building which was necessary was carried out. Today hundreds of thousands of people are without permanent homes. It will take at least three years of energetic building to catch up. The high prices of building materials have not been reduced despite the fact that the war has been over for some time With the gradual return of normal prices, the building of homes in this country will go forward with great haste and architects will be kept busy for several years designing homes and apartment buildings. In New York City alone one hundred thousand families are without apartments to live in.

The Remarkable Conduct of a Drop of Mercury

THAT lower organisms, such as amoebae, infusoria, bacteria and others that are capable of independent movement, are attracted by certain chemical substances has been known a passably long time already For instance, fill a capillary tube with a weak solution of chlorate of potash or of peptone and put into it a drop of mercury in which bacteria are moving, after a few seconds these will be seen hastening to the mouth of the tube where they will all have assembled The amoebae and the naked little masses of jelly (plasmodia) of the myxomycetes (mucous fungi) creep in their peculiar way by stretching forth their arms or feelers toward the stimulant. This faculty of such organisms, of accepting the attraction of certain substances, is called chemotaxis. Chemotactic susceptibility is evidently an advantage for these creatures as it leads them to good nourishment and keeps them near it.

Very recently an eminent physiologist made the discovery that a drop of mercury can make very similar movements. The starting point of his investigation was afforded by the experiment made by Paalzov in 1858 The latter put a drop of mercury in a little flat vessel, over this drop he poured sulfuric acid and then laid a small crystal of bichromate of potash immediately beside the mercury The result was a periodical change in the shape of the drop of mercury which alternately approached the crystal, while flattening itself in front, and receded from it This occurrence was provoked by the fact that the bichromate of potash, aided by the presence of the acid, oxidized that portion of the surface of the drop of mercury turned toward it and thus diminished the tension of the surface of that side of the drop. As soon as the peroxide of mercury, which had been produced, dissolved in the sulfuric acid the surface of the mercury became metallic again and its tension increased In the first instance the mercury flowed toward the crystal, in the second it sprang back.

The physiologist, explaining his application of this experiment, states that through appropriate manipulation he imparted to a drop of mercury the faculty of real locomotion One of the most successful forms of his experiment was this he put a drop of mercury in a suitable dish, of glass, of which the bottom was perfectly level, then he poured in a sufficient quantity of diluted nitric acid and laid a little piece of bichromate of potash at a distance of several centimeters from the drop of mercury on the bottom of the dish The yellow solution of the crystal began to spread itself in a circle and as soon as it reached the drop of mercury the latter with a curt tremor began to recede and then dashed straight to the crystal which it reached in a few seconds. In the liveliest manner it repeated this twitching movement If, in consequence, the crystal moved away in any direction the drop pursued it, receded and approached, again and again, with a movement of mingled leap and glide, while stretching forth the long tentacles and quickly drawing them back again

These remarkable phenomena may be considered as adequate support of the view held by the botanist, Bathold, the physicist, Quinke, and the physiologist, Verworn, that the amoeboidal and related movements are the result of changes in the tension of the surface of the living substance Obviously, though, there are still other conditions which can vary largely the movements of the living prototype.

What Makes the Glow-Worm Glow?

What Recent Investigations Reveal in the Matter of the Luminous Organs of Various Insects and Sea Life

By William Crowder

THE nature of phosphorescence in light-producing animals has been a phenomenon which has engaged the attentions of investigators from a time far ante dating the history of modern science It was only recently, however, that the attempt to fathom the mystery was met with any appreciable degree of success.

Contrary to the popular opinion, the peculiar property of emitting phosphorescent light is by no means a rare one or confined to a narrow range of individuals In the animal kingdom, in groups ranging from the protozoa to the vertebrates, there are more than three hundred genera which contain one or more species that are known to be phosphorescent By far the great majority are those forms which live in the sea. Of these, perhaps the best known are Noctiluca, a microscopic animal which causes the phosphorescent light in the wake of a vessel, jelly fishes, which produce flashes of light when colliding with a boat or struck with an oar; marine worms and small crustaceans.

As may be suspected, from their higher development, the fishes which inhabit the deep sea contain types which have the luminous organs specialized in a manner well-nigh perfect in their arrangement The complexity of these organs may be understood when it is stated that in some individuals they function somewhat after the fashion of an eyeball, that is, they can be rotated to direct the light or turned completely to shut the rays off In others there is an apparatus similar to an eyelid which acts as a curtain by which the light can be shut off or turned on at will It is significant that those fishes distinguished by these extraordinary organs spend their entire lives at great depths far below the point penetrated by the light of day

Of the land forms perhaps the most familiar phases of luminescence are to be found in the fireflies and their larval young, the glow worms From the preceding statement it is evident that the "glow worm" is not a worm, neither is its cousin the "glow worm" of Europe, so often met with in prose and poetry The latter is merely the wingless female of a Lampyrid beetle. In fact, all fireflies belong to the *Lampyrida* a name derived from a Greek word which means to shine" It may surprise some to learn that this subfamily has more than fifteen hundred species of fireflies, and two hundred and thirty of these, distributed among forty two genera, are from the United States alone

To what purpose many light producing animals are endowed with this remarkable power is open to much conjecture Where an apparently valid reason can be ascribed in some instances the same cannot be maintained in others Thus, for instance, in fireflies this function was presumed to enable the sexes to identify each other in the darkness of the night, at which time their activities are greatest If this be true, why, in the case of those species where the female is wingless does the male emit light? Her inability to approach him surely would seem to indicate that the flashing of his lantern avails him nothing

Another instance of the purposelessness of this power is to be found in those abyssal types of crustaceans which are totally blind In this connection, however it may be mentioned that these sightless creatures are devoid of complex photogenic organs, their phosphorescence being due to a luminous secretion

Again certain deep-sea prawns were recently found whose luminous organs lighted only the gill cavities of the animal What function they perform for the benefit of the owners, located as they are, impossible of shedding any external light defies speculation

Perhaps the most intensely luminous animal for its size is the small marine ostracod crustacean, *Cypridena hilgendorfi*. So powerful is the light from this creature that one part of the luminous gland in one billion six hundred million parts of water will give a visible glow to that medium If a man possessed an organ which gave the same proportionate volume and intensity of light as in *Cypridena*, he could illuminate the area of a fair-sized city

It has long been known that many fats, ethereal oils and alcohols emit light when these substances are slowly combined with oxygen at certain temperatures. With this hint it was inevitable that phosphorescence in organic materials could be produced artificially and in a way that would bear a close analogy to the principle involved in the organs of light producing animals. Therefore the 'pyro experiment became a classic achievement in this direction

Pyrogallol, an organic compound of vegetable nature, is commonly known through its use as a developing reagent in photography If pyro or gallic acid and hydrogen peroxide be mixed with the juice of any ordinary vegetable such as a potato, turnip, etc, a decidedly phosphorescent light occurs Now as pyro is noteworthy for its property of combining with oxygen, it is at once apparent that what takes place here is a process of oxidization It is remarkable, nevertheless, that although many compounds can be oxidized by a peroxide mixture, so far as known only pyro and gallic acid will oxidize with the production of light

The next step in these most interesting experiments was taken with the photogenic organs of the animals themselves Of all the light producing animals, perhaps none has lent itself more to inquiry than one of our commonest fireflies, *Photuris pennsylvanica*

Dissection of this insect shows that the photogenic organ consists of thin layers of light colored transparent tissue which overlie a deeper and opaque region The function of the former seems to be for the transmission of the light, and the latter is both a reflector and the fuel generator For intimately connected with this area is a network of air tubes, nerve terminals and the glands which secrete the globules of luminous compounds. These compounds have been separated in the laboratory and have been found to consist princi

(Continued on page 70)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

White Yolks of Eggs

To the Editor of the SCIENTIFIC AMERICAN

I hope you will pardon some further correspondence from me concerning pigments, but a note entitled White Yolks of Eggs" in the May 14th issue of the SCIENTIFIC AMERICAN has attracted my attention It struck me as most peculiar that it was necessary for the SCIENTIFIC AMERICAN to quote the German *Umschau* in regard to work by *American* investigators. The work which was cited was published by me in a series of three papers in the *Journal of Biological Chemistry*, Vol. 39, pp. 299-377, 1919, and also in the *Proceedings of the National Academy of Sciences*, Vol 5, pp 582 587, 1919 The experimental work was performed at the University of Missouri with which I was formerly connected

I have noticed that scientific data sometimes gather inaccuracies in restatement a good deal like the proverbial stone Permit me to point out several such errors in the article entitled "White Yolks of Eggs" which was evidently a translation from the German

The first error is inconsequential, but pertains to the reference to myself and Professor Kempster as poultry breeders. This may apply to Professor Kempster, who is Professor of Poultry Husbandry at the University of Missouri I have no objection to the title for myself, but I fear that the men actually in the profession would resent my being so considered Another trivial error is the reference to the ear lobes of fowls as *earlaps*. I am sure the poultry folks would not agree to this terminology A third error is more serious for it involves a scientific fact. The natural yellow pigment of egg yolk is not carotin, but xanthophyll, the carotinoid which is closely related to carotin and almost always associated with it in plants. It so happens, however, that carrots contain very little xanthophyll, so little, indeed, that when carrots are fed to laying hens, there is practically no effect on the color of the egg yolk (see paper by me in *Journal of Biological Chemistry*, Vol 23, p 261 1915) On the other hand, yellow corn is very rich in xanthophyll with very little carotin so that the feeding of yellow corn greatly enhances the color of egg yolks Both carotinoids are present apparently in green feeds so that the latter readily increases the color of egg yolk when fed to laying fowls.

A curious physiological fact in connection with these relations is that the natural yellow coloring matter of milk and butter *is* carotin and this carotin bears similar relations to the feed of the cow that the xanthophyll of egg yolk does to the feed of the hen In this case, however, carrots greatly increase the color of butter, but yellow corn has no effect (see papers by me in *Journal of Biological Chemistry*, Vol 17, pp. 191-249 1914)

Finally, the whole story of white yolk eggs is not quite true after all As far as being free from natural yellow pigment derived from the feed is concerned they were white The yolks of cooked eggs were perfectly colorless, but the raw yolks contained a very slight amount of yellow coloring matter which could be extracted with suitable solvents, so in reality from a strictly scientific point of view the yolks were not *absolutely* colorless This trick' is, I fear, hardly attainable, for the hen apparently makes a little, although very little to be sure, of her own egg yolk coloring.

LEROY S PALMER, Ph D

University, Minnesota

The Lunar Zodiacal Light

To the Editor of the SCIENTIFIC AMERICAN

My attention has been called to an item "Lunar Zodiacal Light," in your issue of June 11 summarising part of my report to the director of the aurora and zodiacal light section of the British Astronomical Association The following comment by Mr Gavin Burns, director of that section of the B A A., is quoted "As the light of the full moon is only about one-millionth the intensity of sunlight it is difficult to believe that the phenomenon described can be due to the light of the moon."

Chaplain Jones, U S.N., was a specialist in zodiacal light observations. His report of observations made during the U S. Japan Expedition (1853-1855) forms Vol. III of the Expedition Report published in 1856, and contains 328 observations charted and described. The range of latitude extended from 42° N to 53° S Nearly 50 per cent of the observations were made within the tropics He is very particular in describing what he calls the moon zodiacal light which he witnessed in the tropics He also witnessed what he termed a joint sun and moon zodiacal light In his report of one of these observations he says "The moon quartered today (March 6, 1854 lat 25° 26' N long 139° 42' E) At half past 7 I was astonished to see the zodiacal light fully displayed It was no doubt a joint sun and moon zodiacal light My mind was perfectly satisfied that it was clearly a zodiacal light It differed from the ordinary zodiacal light in not being brightest at its lowest end but was all the way down of a fairly uniform brightness It was quite distinct. The upper end was lost in the moon's superior light. The night was very clear" Naval officers corroborated this and similar observations. As to my observation in southern Maryland on the evening of February 21, 1916, of which I retain a vivid recollection The moon was three days past opposition in right ascension 12 h 9 m and declination 5° 42' S The fact of the light was unmistakable The sky was cloudless and the seeing remarkably good The moon was the only source of light sufficient to produce the effect Hence it seems quite appropriate to describe it as a lunar zodiacal light

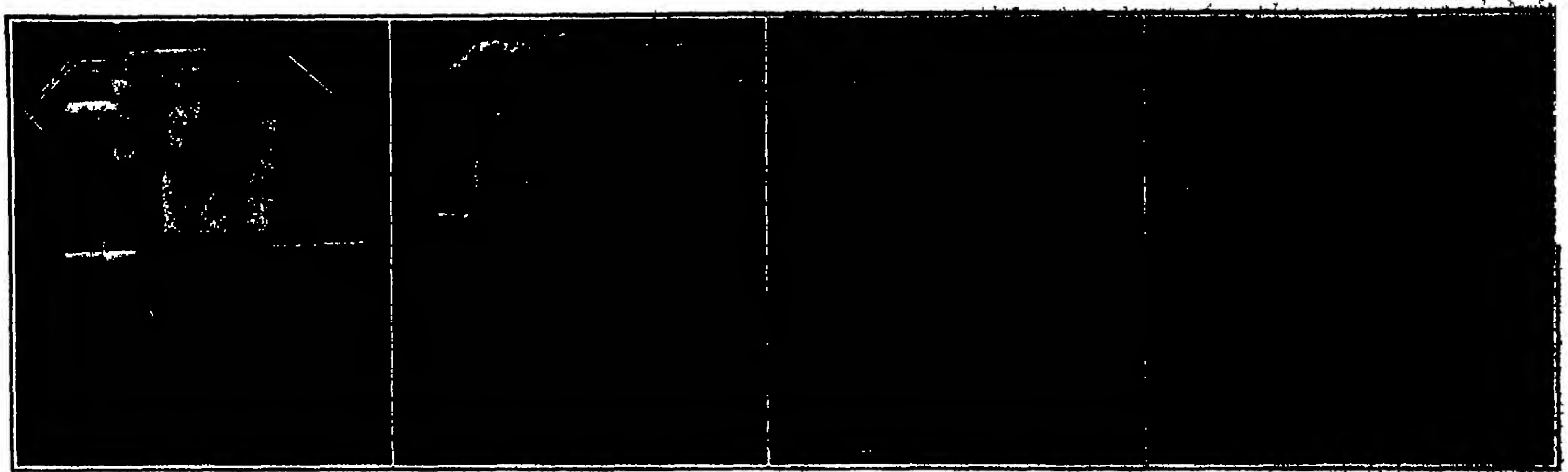
Baltimore, Md W E. GLANVILLE.

Substitutes for Wood in Papermaking

To the Editor of the SCIENTIFIC AMERICAN

In connection with my paper article in your issue of June 11th, may I point out that in considering substitutes for rags wood and straw, it is important to bear in mind that, while many plants, grasses, reeds, etc, are capable of being utilized in the manufacture of a satisfactory paper pulp, freight charges from point of production to mill must be less than the freight charges on pulpwood, a sufficient yearly growth must be assured to operate a mill continuously, and the cost of chemicals used in production must not, for example, exceed that involved in the pulping of straw while a *sine qua non* is that the yield of cellulose fibers must amount to more than one-quarter of the total bulk of material treated This at once rules out many of the hasty and ill-considered suggestions and propositions that have been put forward

New York. THOMAS J KEENAN



1 The rail-section machine in position to trace the contour of the top or tread of a rail. 2. The back of the rail-section machine, showing the spring handles and the method of holding the apparatus firmly against a rail while making a record. 3. The T-frame swung to the left and in a vertical position to trace the side contour of the rail head. When shifted to a corresponding position on the right, the apparatus is ready to record the contour of that side of the rail. 4 The rail-section machine in service and about to record the wear of a rail at a troublesome point on a curve

Some phases of the application of the rail-section machine in determining rail wear and tear

Reporting the Life Story of Rails

How Railroads Employ the Rail-Section Machine for Determining the Wear and Tear on Their Tracks

By Robert G. Skerrett

THE incurious commuter, the accustomed traveler, and the shipper generally give precious little heed commonly to what might be termed the minor aspects of railroading upon which transportational safety, comfort, and economy of operation depend The disposition of the public is to take much for granted in the management of our vast network of land lines, largely because their security en route and the proper and prompt carriage of their commodities are assured as a rule But back of this record of work well done is a story of ceaseless vigilance, and the object of this article is to describe an ingenious apparatus which makes it possible to detect wear and tear in certain vital directions related to the maintenance of way and the efficient upkeep of the rolling stock.

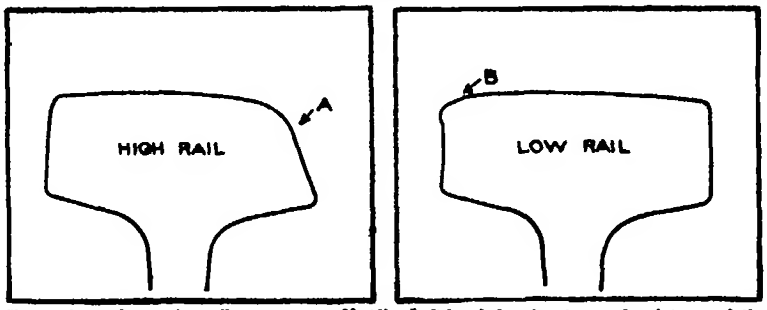
Considering the masses in motion and the speed at which trains of various sorts move there is, indeed, ample warrant for wonderment that the ribbons of steel are capable of supporting and guiding the fast expresses and the pounding freights, and no less astonishing is the fact that the comparatively thin flanges of the whirling wheels are the sole mediums relied upon to hold the locomotives and the cars upon the rails Neither the track nor the wheels would answer for these exacting purposes if both were not kept fit for the service expected of them.

Not only is the gage or distance between the track altered as a rail head is worn or deformed by the blows and friction of the passing wheels, but these modifications may lead to two things they may cause the rail to fracture or they may induce the derailment of a train—an accident that may range from a delaying mishap to an appalling disaster. Again, if watchfulness is not continually directed to the wheel flanges these may be so ground down as to make them likely to break when suddenly subjected to lateral pressure in taking a curve or when passing over a switch or frog point This is fairly certain to bring about a derailment And now let us see what it is that one of our great trunk lines employs for the frequent examination of its rails and the wheels of its cars and locomotives

The rail-section machine, as such, is not a novelty—the Germans having been the first to devise an apparatus of this nature, but the older instruments have uniformly been heavy and cumbersome and so troublesome to function that no one wanted to use them except when forced to do so Further, they have been notably limited in their field of application—in short, helpful only in registering the condition of a rail head Appreciating these drawbacks, Mr B. F Duel, one of the track engineers of the New York Central Lines, set about some years back evolving a modified mechanism that would be much lighter than any existing rail-section machines and which, besides, would answer just as readily for recording the state of the tread and the flanges of the rolling-stock wheels.

After considerable study, Mr Duel produced his perfected apparatus five years ago, and the little machine weighs complete but seven pounds. Its less flexible competitor at that time tipped the scales at 30 pounds. The present instrument can be tucked away in the bottom of a handbag and can be brought into action in a few seconds. This is of much importance on a busy railway where the interval between trains is not long and where many of them travel at high speeds.

On the main line of the New York Central Railroad, between New York City and Buffalo, records are made by means of the rail-section machine at approximately 400 points. The object is thus to get an index of traffic influence on the rails at these characteristically troublesome positions along the line The practice is to register graphically the condition of the several rails or tracks at each of these places, and then to inspect in the ordinary way the trackage lying a short distance beyond in both directions. The closeness of this examination is determined by what the rail-section card reveals.



The sections of opposite rails on a curve 3° 40'. Left-hand drawing is a reduced trace of the contour of the high outer rail. *A* indicates where the side pressure of the flanges of the passing wheels has ground away the metal. The right-hand drawing is a reduced trace of the low or inner rail. *B* shows where the over-riding action of the wheels causes the metal to flow outward while at the same time grinding away the tread

How the rail-section machine reports the story of rail wear

Because of the seasonal convenience and the facility with which labor can then be obtained, it is customary to lay new rails in the summertime Then the effects of traffic upon these rails are checked up by the apparatus the next spring. By this procedure it is feasible to get a good idea of the wear and tear of half a year's service The real significance of the records of the rail-section machine becomes apparent when the tonnage that has been moved over the rails during the previous six months is compared with that of the year before and the state of the track at that time. Assuming the traffic at both periods to be the same, then the engineers of the Maintenance of Way Department can tell, according to whether the new rails are showing more or less deformation, just how well these steel members are meeting the road's requirements. With such a system of surveillance in operation continually, and rails are normally expected to stand up for a number of years, each succeeding record, in combination with the tonnage carried for a given period, adds another page to the life history of the rail in question It discloses how and when to take steps to neutralize or to offset the grinding and the pressure of car and locomotive wheels.

On the New York Central Railroad's main line the maximum curves are of 7 degrees, while upon tributary coal lines the curves are frequently of from 10 to 12 degrees, and there are places along these sinuous routes where the bends are of 14 degrees. Indeed, there are long stretches of this railway system where the straight or tangent sections do not represent more than 40 per cent of the run. Therefore, it is essential that the curves be looked after with the utmost care, for the rails at these points are subjected to the greatest stresses and the most abuse Besides furnishing data covering the effects of different services upon the rails; bringing out the special physical conditions that must be met at particular points, detecting whether or not the rail is giving a maximum of usefulness, and settling disputes between section bosses and inspectors as to the fitness of a rail to remain in place, the rail-section machine determines to a nicety whether the rail can be reversed and used in the same division or if it would be wiser to shift it to another track where the traffic demands are less trying.

By the timely reversing or transferring of rails, as the case may be, the men of the Maintenance of Way Department are able to get the fullest measure of use out of the rails before they are scrapped This procedure makes for very substantial economies in the upkeep of the roadbed, and the systematic and intelligent employment of the rail-section machine is thus instrumental in saving many thousands of dollars annually Before describing the adaptation of the apparatus to the recording of the flange and the tread contours of wheels, let us explain briefly the general get-up of the machine.

Broadly, the instrument is composed of a light metal main frame carrying a hollow sliding frame which moves horizontally on roller bearings, and this sliding frame, in turn, supports an adjustable T-frame which can be set to travel either horizontally or vertically. This T-frame holds a pencil point centrally located, while at the three extremities of the T-frame are mounted adjustable pins. These pins, according to the position of the T-frame in relation to [illegible] successively in contact with the [illegible] of the rail head, and as they [illegible] pencil reproduces on a card [illegible] rail. At the back of the [illegible] handles which [illegible]

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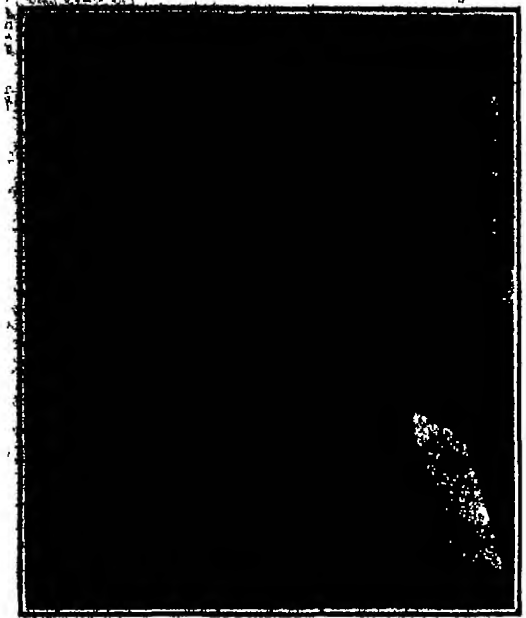


German workman constructing his new home of former munition boxes

From German Munition Boxes to Workmen's Houses

NEAR Eberswalde, Germany, the building shortage is being met through the erection of unique houses —unique because of the material being used in their construction The accompanying photograph shows that Eberswalde workmen are using old munition boxes in constructing new homes, in place of bricks which are very costly and difficult to get The new houses are constructed by first erecting a framework, as shown in our photograph, and then filling the framework interstices with old munition boxes. It appears, too, that the munition boxes are filled with concrete so as to make the construction highly substantial The munition boxes are so well made, with their heavy wood and mortised corners, that the wooden "bricks filled with concrete make an ideal wall

What Is the Aurora Borealis?

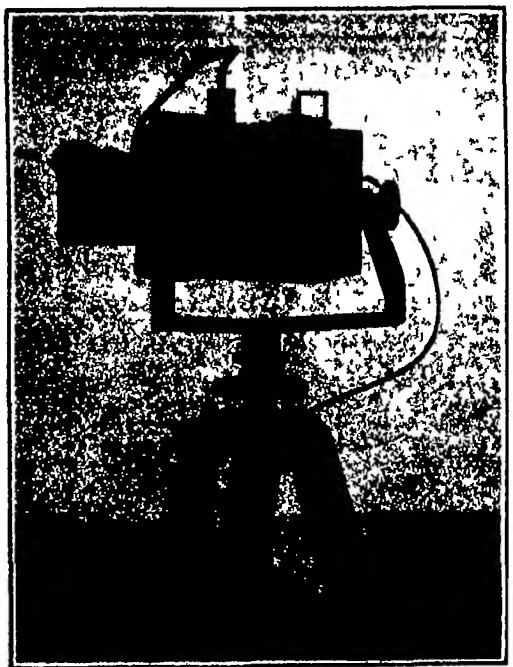
AS early as 1881 the idea was put forward by Goldstein that the sun sends out into space streams of electrically charged particles, which may give rise on the earth to electric and magnetic phenomena In 1888 Poulsen applied more or less the same theory definitely to the aurora borealis. Birkeland, however, was the first to give a real basis to the theory that the aurora is due to electric discharges from the sun

Birkeland discovered, in 1896, that a magnetic pole will concentrate a beam of light rays at a single point, much after the manner of a lens. The suggestion was immediate in his mind that the earth, acting as a huge magnet, might in like manner concentrate cathode rays or similar electric radiations from the sun, bringing them, of course, toward the northern and southern magnetic poles.

Physical confirmation for this theory was secured by Birkeland in 1901. In a large vacuum glass jar he suspended a small magnetic sphere, and directed toward it ordinary cathode rays. While the sphere remained unmagnetised, the rays touched only one-half of it, over which they distributed themselves uniformly quite as might be expected. As soon as the sphere was magnetised the rays distributed themselves in hornlike bundles, the points of which lay in ring-shaped zones about the two poles. The correspondence between the illuminated areas of the sphere and the north and south auroral belts of the earth was very close.

Birkeland's first idea was that the aurora was due to secondary cathode rays, originating from vast systems of electric currents in the extreme upper atmosphere, which in turn were formed by cathode rays from the sun. Later he amended this theory to the extent that he came to regard the aurora as itself produced directly by the cathode rays from the sun By 1913 he was committed to this alternative

In the meantime Carl Störmer interested himself in his colleague's work, and being a mathematician he began to wonder whether it would not be possible by pure mathematical means to obtain the details of Birkeland's experiments, and to discover the essential characteristics of the auroral phenomena The results of his investigations were published gradually over a term of years. Broadly speaking, the problem was visualized as one in the dynamics of moving particles—the electrically charged particles from the sun and it was of course treated by considering the differential equations that define the motions of such particles The "integration" of these equations, as the process of solving them is called, is a very long and complicated one. About as close as one can come to explaining to the layman why this should be so is to explain to him that in each equation there occur not one, but a number of unknowns (the dependent and independent variables and the derivatives of the former), that there exist between these definite relations, but relations of such a sort that the numerical values of some of them do not aid us at all in finding the values of the rest until after we have solved the equation, and do not aid us in this solution either, while the equations themselves have to be considered in groups, and do not yield at all to direct algebraic attack. What has to be done is to find, by a lengthy process of trial, algebraic expressions for the relations that are known to exist between the unknowns, and of such character that they will satisfy the conditions laid down by the several differential equations of the system under consideration These algebraic expressions turn out in practically every case arising in practice to be infinite series, and the computer has to discover the terms of these series one at a time, by laborious calculation of



Special camera employed in making photographs of the aurora borealis

the coefficients, and to proceed until he has assured himself that he has enough terms so that his numerical results are a sufficient approximation to the truth It is not an easy or a pretty process, and one who knows differential equations can easily credit Störmer's statement that the work had to be subsidized by the Nansen Fund, and that 5,000 hours of calculation were used up on it—an enormous task to be sure

The object would naturally be to determine those trajectories which could be taken by electrically charged particles from the sun under the influence of the sun's and the earth's magnetic and gravitational fields, and which would bring the particles following them into actual contact with the earth Of course such trajectories taken at random would display a large preponderance of probability in favor of missing the earth, and in fact the investigators found that the few trajectories they could get to hit the earth did not throw sufficient light upon the problem, and that it would be necessary to work it backwards, starting from the earth with paths known to have arrived at the earth, and tracing these back to see how the corresponding particles had left the sun and how they had behaved on approaching the earth This method of attack upon the problem was a complete success, and a complete mathematical characterization was formu

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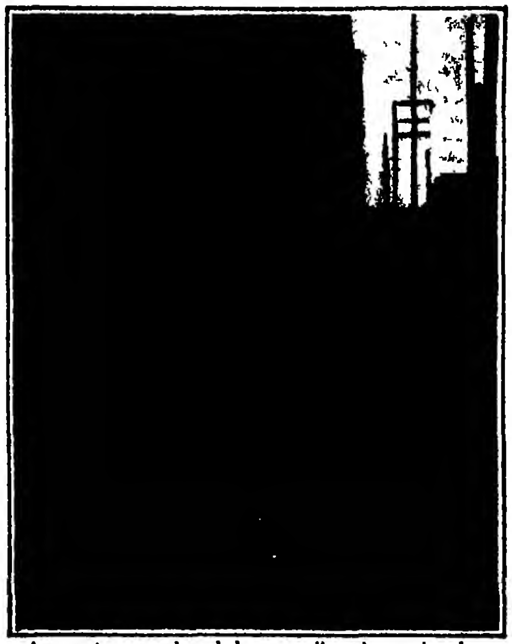


Apparatus employed by a railroad repair shop for the purpose of cleaning out boiler scale

Using Sand, Compressed Air and Water to Clean Boilers

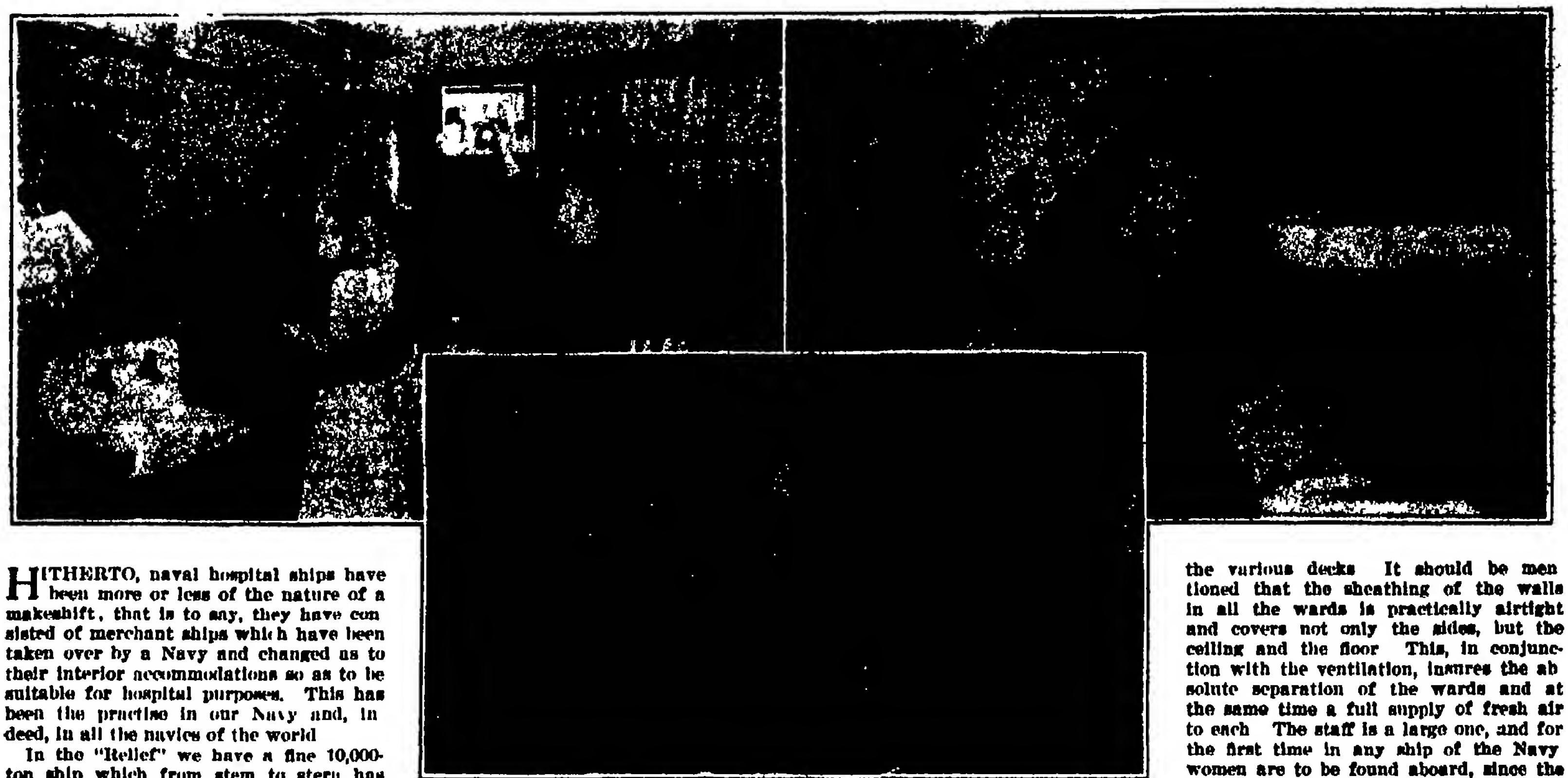
A DEVICE has been perfected and placed in operation by the Southern Pacific Railroad in which water at 125 pounds pressure is mixed with compressed air and sand, and the mixture directed against boilers and boiler flues by a special gun the purpose being to clean the scale from the flues and boiler By means of this combination the scale is not only entirely and quickly removed, but as it is removed it is washed down with the water and sand leaving the flues and boiler perfectly clean There is no dust or sand floating around in the air, as is the case when sand is used with compressed air alone By this new system other workmen can work within a few feet of the sand air and water gun without being inconvenienced in the least

In the view shown above A indicates the hose that delivers water at 125 pounds' pressure to the gun, while B indicates the hose that delivers the sand under air pressure to the gun, and C indicates the hose that delivers air alone to the gun The entire equipment is mounted on a four-wheel truck, enabling the equipment to be readily taken from one job to another The sand is placed in the metal drum, and then compressed air is turned into the drum, which serves to deliver the sand into the gun where it is caught up by the air pressure and the water pressure and directed against the parts of the flues or boiler to be cleaned

Strip of motion picture film of the aurora borealis. Each "frame" or picture was recorded by a four-second exposure

Our Floating Hospital

Some Features of the United States Navy Hospital Ship "Relief" Built Specifically for Hospital Purposes



1 The pharmacy, provided with metal cabinets in accordance with the latest practise. 2 One of the sick bays. 3 Scene in the sterilising room

Some features of the Naval Hospital ship "Relief"

HITHERTO, naval hospital ships have been more or less of the nature of a makeshift, that is to say, they have consisted of merchant ships which have been taken over by a Navy and changed as to their interior accommodations so as to be suitable for hospital purposes. This has been the practise in our Navy and, in deed, in all the navies of the world

In the "Relief" we have a fine 10,000-ton ship which from stem to stern has been designed specifically as a hospital ship Our naval constructors claim, and with very good reason, that she is not only the latest, but the most perfectly equipped vessel of her kind afloat Before drafting out her plans a very thorough study was made, not merely of other hospital ship practise, but of the latest hospital practise in the big shore establishments both of the Navy and of the various municipalities. Consequently, from the hospital standpoint, the "Relief" represents up-to-date practise in the arrangement of her wards, operating rooms and general equipment She was built as a fleet hospital ship—that is to say—she will accompany our fleet upon its cruises and will be always at hand to receive, care for, and bring back to health such members of the personnel of the fleet as may be injured or otherwise placed temporarily on the sick list.

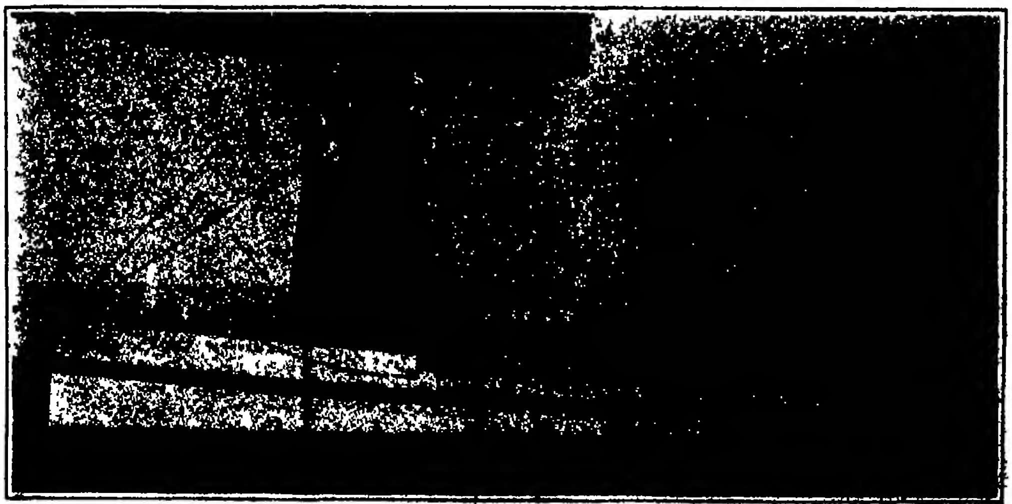
The "Relief" is 400 feet long between perpendiculars and 483 feet overall Her beam is 61 feet, her molded depth 39 feet 3 inches, and her draft 20 feet. On this draft she displaces 10,000 tons, and her speed is 16 knots On looking at the photographs of the ship the eye is at once caught by the large perforated structure below the bridge This encloses the operating room, and the dark spots, numbering about 100 in all are large, two-foot portholes, which cover the whole top and sides of the structure In the room are two tables and two smaller operating rooms. A special system of shades is provided so as to enable the surgeons to get exactly the light which they require, both as to quantity and direction It is needless to say that this room contains the very latest operating equipment.

The ship can accommodate 500 patients, and it is divided into three distinct sections for the officers and staff, the crew and the patients. The contagious disease wards are carefully separated from all the other wards being located aft on the upper deck

Among the specialties on the ship are the "mechanical cow," a device for producing synthetic milk, which cannot be distinguished from ordinary milk either in taste or quality This is produced in quantities for the use of the patients. Also the ship contains hydro-therapeutic rooms, dental rooms and eye, ear and nose rooms, en suite, the ear rooms being made sound proof There is even a mortuary in which twelve bodies can be refrigerated.

Carefully screened off from all other compartments is the X ray room, most elaborately fitted and lead lined throughout In a remote part of the ship is an animal pen for the production of serums.

Every possible thing has been done on the "Relief," not merely to assist the surgeons in doing rapid and effective work but to render the hours of convalescence as comfortable as possible for the patients. Particular attention has been paid to the lighting, which has been so hooded as to throw the light away from the patients' eyes A special system of quadruple-flow ventilation has been built in the "Relief" She has been supplied with several elevators running through the various decks It should be mentioned that the sheathing of the walls in all the wards is practically airtight and covers not only the sides, but the ceiling and the floor This, in conjunction with the ventilation, insures the absolute separation of the wards and at the same time a full supply of fresh air to each The staff is a large one, and for the first time in any ship of the Navy women are to be found aboard, since the nursing staff includes several female nurses. The "Relief" is a large ship, but none too large for her duties, even in peace maneuvers. The personnel of a fleet, with its auxiliaries, runs to large figures. A single modern battleship houses over 1500 officers and men



U. S. S. Naval Hospital ship "Relief"—10,000 tons, 16 knots. This is the first ship in any navy to be designed specifically for fleet hospital service

Use of Photographs in Swiss Advertising

SWISS business firms display great talent in artistic advertising Wrappings are not only always neat and appealing in subject, form, and color, but the pictures and photographs, whether accompanying sales or used as display advertisements, are particularly attractive These in almost all cases portray some well known national event, or some artistic and historic piece of natural scenery The big chocolate manufacturers and watchmakers of Berne are particularly adept in appealing to the eye

The Swiss have learned more thoroughly than the American manufacturer and seller that no amount of expertly written description of anything, whether it be machinery, chocolate, a watch, or a music box, can tell the story as well as a good photograph The principal reason of this is due, not so much to a greater imagination and artistic temperament, as to a conscious feeling that among so many different European languages a universal appeal has a greater and a more attentive audience For example, to an American machinery company a visualization to the foreign buyer of American export machinery would certainly be of value in impressing non-technical men such as the average European board of directors and even skilled engineers.

American articles sold to Switzerland, as well as those sold throughout all Europe, yield themselves easily and readily to the photographic idea. If the commercial travelers in the United States are now finding that the picture method yields such increased business, it would be equally advantageous if used abroad.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Running the vacuum cleaner over automobile upholstery for a thorough cleaning

A Vacuum Cleaner for the Automobile

CONSIDERING the expanse of upholstery in the average automobile, and more particularly the little corners and pits in which dust accumulates and resists most efforts to dislodge it, there is a clearly defined field for the vacuum cleaner designed for automobile use. The accompanying illustration shows a vacuum cleaner for automobiles, that has recently been introduced. The outfit consists of the dirt container, a connection with the intake manifold of the engine, a long flexible hose and the nozzle. The nozzle is run over all parts to be cleaned and the dust is sucked up and delivered to the dirt container. The dirt container can be removed with a twist of the wrist and the contents emptied. The dirt container can be installed under the hood or under the dashboard, as shown in the illustration.

An Automatic Fire Alarm for the Home

THE ever-present danger of fire in the usual frame building or house can be reduced to a large degree by providing means for detecting fire at its very inception. Among the various fire-detecting devices that have been placed on the market is the type shown in the accompanying illustration, which has simplicity and dependability to recommend it.

This new fire detector closes any circuit in which it may be connected when the air in the immediate vicinity rises above a certain predetermined point. Thus the outbreak of fire may be signaled by the ringing of a special fire bell or the regular house bells. Any number of detectors may be installed on one circuit in parallel, or on separate circuits connected with an annunciator so as immediately to indicate the exact location of the fire. In this manner this device becomes available for the average home where a detector can be placed in the cellar to guard against fires, or in the average factory, store, school building and so on, where a number of units are required.

Open side of fire detector, showing the lugs that hold it in place and the wire connectors

Combination Tank for the Motor Gypsy

THE attractions of motor vacations and outdoor living lead many families to wander far from restaurants and fuel stations when adequate supplies for man and vehicle can be easily transported. A new combination tank has been designed to fit neatly upon the running board, without interference when entering the car. In one model of automobile this tank is standard equipment and a place has been made for it at the rear of the chassis.

In the center of the handy carrier space is provided for provisions, together with ice to cool food and beverages for the day's journey. Another compartment holds tools. Any one who has ridden beside the driver and had to climb out every time a wrench was required from the box beneath the seat will appreciate the tool compartment feature. Three other spaces carry a reserve supply of gas, oil and water, each liquid being quite independent of its neighbors and drawn off through key lock faucets. Locks are attached to both tool and "grub" containers.

Combination gasoline, water and oil tank, as well as food and drink compartment and tool chest for the long-distance automobile tour

Speeding Up the Picking of Apples

FROM England comes the accompanying photograph of a new labor saving device in the form of an automatic apple picker. This machine consists of a number of parallel chain belts which carry numerous cross-arms set at regular intervals apart, the cross-arms being provided with springy fingers. The front end of the automatic picker, which is carried on a pair of bicycle wheels, is close to the ground and terminates in a number of spring fingers. As the machine is wheeled along the ground beneath apple trees, the apples are caught by the lower spring fingers while the belt-mounted fingers, moving all the while, come down and round the front in such a manner as to scoop them and carry them up the incline rails to the bin at the center of the little machine. The belts are driven by a chain belt which engages with a sprocket on the bicycle wheel shaft. It is reported that the apple picker does the work of six men picking up 40 pounds of apples in 1½ minutes.

As this machine is wheeled along the ground it picks up apples and delivers them to a hopper

Pneumatic or Solid Tires for Motor Trucks?

RECENT announcements of motor truck builders show that considerably more interest obtains on the part of truck users regarding the advantages to be secured by using pneumatic tires on heavy vehicles than is generally believed. The president of a prominent concern making solid tires shows in a recent letter that this form is superior for certain classes of work, especially where very heavy loads are to be carried.

The practise of overloading motor trucks is almost universal and it is very questionable whether such a deep-rooted and general habit can ever be eradicated. Most power wagons are designed to carry a reasonable overload and stand up under the abuse which the average motor truck receives. So are solid tires. In other words, solid tires are foolproof and for freight transportation, the simple, foolproof part is only just good enough. Pneumatic tires are far from foolproof. They will not stand such abuse.

It seems a good view to hold that solid tires fill a totally different need than pneumatics and that the two will continue to exist alongside each other, each in its proper place. In deciding on their tire equipment motor truck owners are best advised to render an account themselves of their particular service requirements. If the motor truck is intended for city hauling, they will undoubtedly obtain the best results out of solid tires, generally speaking, whereas, for long-distance hauling, it is largely a question of load. For heavy loads again the solid tire is the logical equipment, whereas for light hauling, and particularly in the case of perishable goods, the pneumatic tire is the better choice, provided always that the increased speed to be obtained out of pneumatic tires can be fully utilized to compensate for the increased cost of tire up-keep.

Recent Patent Decisions

Interference.—Herein is an appeal from a Patent Office decision in an interference proceeding awarding priority to the senior party, Yardley. The invention relates to synchronous booster rotary converters.

The Board of Examiners reached the conclusion that Yardley was the first to conceive and the first to reduce to practice this particular invention. Counsel for the appellant contend that the mere fact that Yardley was the first to conceive and first to reduce to practice is not sufficient ground upon which to base an award of priority to him.

The court herein holds that the Board of Examiners were right in their contention, and the mere fact that one was the first to conceive and first to reduce to practice is sufficient ground on which to base an award of priority. *Reben v. Yardley, U. S. C. C. A. of D. C.*

Something New in Angle Shears for the Small Shop

A CHICAGO manufacturer has just introduced a new angle shear which, it is claimed, is different from any other on the market. The upper shear blade of this machine is actuated by a geared lever. The blade is also reversible and has two cutting edges. An important feature of this shear is the fact that the upper blade can be raised high enough so that the angle to be cut can be inserted from the front of the machine. A hold-down is provided for keeping the angles in place while they are being cut. Weighing only 22 pounds it is claimed that it is less than one-third the weight of any other angle shear. The machine will cut angles 1½ inches x 1½ inches x 3/16 inch and lighter.

Cutting angle iron with a new type of angle shear. Note how the angle is securely held in position

Pulling the Mississippi's Teeth

(Continued from page 60)

The wood work of the boat was also well preserved. The water does not seriously injure the metal or wooden parts of a sunk ship, it is the mud which effects the bulk of the damage. Wrecks which are not imbedded in the mud and sand survive decomposition for many years. During the periods when snag work on the river is not pressing, the snag boats occasionally assist private companies in the raising of river boats which have been sunk at sections of the river adjacent to the open channel Such assistance is furnished at actual cost.

Despite the great increase in labor costs, Congress appropriates the same amount for snag removal from the Mississippi today as 30 years ago. The consequences are that the two snag boats which are supposed to patrol the river from St. Louis to New Orleans are not able to work a full season—the snagging season usually lasts from July until March. Lack of funds is halting this essential work just at a time when the Mississippi River is being used more than ever before. It is now highly necessary to keep the channel clear and navigable and to do everything possible to promote the increased utilization of this wonderful inland waterway It would seem that Congress might allot a few thousand dollars more a year to this meritorious cause

Just to show that the money used in the past has been effectively expended, it may be cited that during a normal season, the two Government snag boats on the lower Mississippi will pull and destroy between 300 and 400 snags, the average weight of these obstacles being between 30 and 40 tons. In addition, they will break up anywhere from 10 to 20 drift heaps which—if neglected—are inimical to navigation. The crews of the two boats in addition will cut between 200 and 10,000 trees which fringe the banks and are liable to be undermined and washed away by the river and ultimately converted into dangerous snags. The conquest against snags in the open channel is well in hand, at this time, and with sufficient funds to continue the work it will be possible to keep the number of acidents due to snags down to a minimum However, to neglect the work at this stage of the game due to lack of funds is a costly, senseless and unnecessary error The American public desires that Congress reduce expenses along sane and sensible lines. It does not wish our legislators to rob Peter to pay Paul in the style evidenced by the 1921 lack of adequate appropriation for the complete and efficient removal of snags from the Mississippi

What Makes the Glow-Worm Glow?

(Continued from page 65)

pally of two substances which are termed 'luciferine' and luciferase."

It was formerly believed that since phosphorescence took place on the oxidisation of oils in alcoholic solutions of an alkali that the material which was oxidised in photogenic organs were fat droplets, but since the separation of luciferin and luciferase, neither of which can be reduced by such fat solvents as ether, benzol, etc, it is, of course, now known that such is not the case. Of the two substances liciferin is the more stable. It will withstand long continued boiling, and will remain unimpaired in its light-producing quality for months. Furthermore, after it is oxidized it is converted into "oxyluciferin," and this latter product can in turn be reconverted into luciferin. Luciferin, however, will oxidise with light production only in the presence of luciferase. Luciferase, on the other hand, is very unstable and deteriorates rapidly

It will, of course, be obvious that the presence of oxygen is necessary in order that luminescence in the photogenic organ can take place. Therefore, we may with great probability determine by inference just what takes place during the flash of the firefly's lantern. As the insect has stored in the glands of its organ a supply of both luciferin and luciferase in a combined form, there is always maintained a more or less steady glow due to the oxidization of the luciferin in contact with the ordinary oxygen absorbed from the air and the oxygen normally contained in the tissues. When the moment of the flash occurs there is an accelerated production of luciferase, during the combustion of which it is rapidly used up, and by a respiratory process the air tubes flood the photogenic cells with a copious supply of oxygen, no doubt operated under pressure.

Exhaustive tests with the bolometer and the spectroscope have shown that the light of Photuris, unlike our artificial illuminants, contain no heat rays and no light rays extending into the infra-red or the ultra violet. That is to say, it is what is termed a "cold light" and that the only light rays which are emitted are those which are visible to the eye. In this respect, as an illuminating device the light of the firefly is tremendously greater in efficiency than any artificial light yet constructed How great this efficiency is will be seen when the comparative values of some of our modern illuminants are given In a photometric curve worked out some years ago it was found that the efficiency of the carbon glow lamp was 0.48 per cent, the tungsten lamp, 1.3 per cent, whereas the firefly had an efficiency of 99.5 per cent. It is evident then that our most efficient artificial light is not more than 4 per cent as efficient as that of the firefly.

A natural question here arises as to whether the light of phosphorescent animals can ever be artificially produced in a way to make it available for domestic and industrial use To dismiss with contempt the possibility of synthesizing animal light would ill become anyone who has seriously reviewed the achievements of the past century And confidently to anticipate that at no long distant date this will be accomplished, would be neither vain in the man of science nor presumptuous in the layman.

Reporting the Life Story of Rails

(Continued from page 66)

and the latter can be swung in under the head of a rail to grip it and to hold the machine firmly in place while making a record The present instrument uses cards while the older machine traced the lines on tin plates which were subsequently inked and prints made therefrom. Besides being heavy and otherwise objectionable, the tin plates were expensive Finally, the Duel mechanism, with its adjustable features, can be set to allow for wear This insures the making of reliable records at all times and greatly prolongs the serviceable life of the device.

In the reading of wheels, whether car or locomotive, there is an auxiliary attachment called a punching frame, a triangular affair carrying three steel points. This is first fitted over the tread and flange, and a hammer blow on each punch leaves an enduring mark on the rim of the wheel. Next, an aluminum yoke or tire base is centered upon these three indentations, and then the rail-section machine is secured to this base. With this done, it is an easy matter to reproduce the outline of the wheel's tread and flange. The cards employed for this work are larger than those used in recording rail sections, and they can be repeatedly inserted in the apparatus with precision so that subsequent tracings can be made thereon to illustrate the various wearing stages of the wheel. Whenever this is done the instrument is set at the same spot on the wheel, as indicated by the permanent marks made by the punching frame.

On one face of every wheel there is a

... known to the railway ... the "wear groove" This ... from which to measure ... wheel tread and down ... point a wheel may be worn before ... be condemned When the ... apparatus shows that the wheel ... wearing evenly and that it may be ... fit again by being turned down in a lathe, the wheel is sent to a shop for that purpose. There the men that do this are paid on a piecework basis and agreeably to the amount of metal that has been removed Not infrequently their claims for compensation are disputed and the rail section machine comes into play to settle the question Further the instrument is often relied upon to establish how much the wheel shall be turned down

The wear on wheels is a sure index of the way wheels are mounted and it is important therefore that this work be done correctly In a locomotive for instance, the wear on different wheels when not uniform is unmistakable evidence of improper mounting, somewhere and this condition may be such as to hamper seriously the efficient and economical performance of that tractor Happily a rail-section machine like that developed by Mr Duel makes it practicable to detect any irregularities in their infancy and to take the steps needful to remedy them Inasmuch as the locomotive is the prime mover and all of its powerful tractive effort is exerted through its wheels upon the rails, it should be plain that when these wheels are not mounted aright they are correspondingly apt to be more destructive to the track It is to the advantage of the railroad and to the benefit of the public that these harmful sections be checked at the very start in order to avoid outlays and accidents for which the people at large must pay sooner or later The rail section machine is proving a very valuable agency in this direction

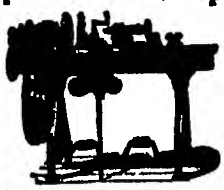
What Is the Aurora Borealis?

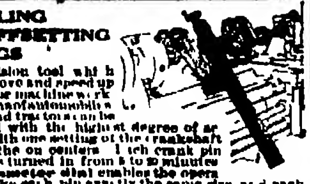
(*Continued from page 67*)

lated of the trajectories that would hit the earth This was checked up with Birkeland's observations on the small sphere and it was found that the mathematical results checked up exactly with his physical ones, and both as stated above with the aurora itself Perhaps the most remarkable feature of these trajectories is the manner in which they circulate about the earth and descend upon the side opposite the sun to make the auroral apparition possible at night, on the side of our globe turned away from the sun that is responsible for the whole thing The mathematical theory explains perfectly a number of the subsidiary features of the physical occurrence of the aurora such as the occurrence in zones and the formation of the characteristic arcs and draperies In a word what we call the aurora borealis is precisely the light produced by the electric rays from the sun under the resistance of the earth's atmosphere

Dr Störmer was not content to let his investigation of the aurora stop here however He took up the challenge implied in the fact that satisfactory photographs of these displays had never been made' and so effectively did he dispose of this challenge that he has in addition to a large number of ordinary photographs successfully "obtained" motion pictures of the aurora. The chief difficulty in still or motion pictures of this subject lies in the matter of exposure. Dr Störmer's motion films of the aurora are unique in that each panel is exposed for four seconds before it moves on and gives place to the next one.

Dr Störmer has contributed, to the SCIENTIFIC AMERICAN MONTHLY for July an extensive account of his own and Birkeland's work with the auroras, together with a large number of photographs, both still and motion. The present discussion is a résumé of his text.





Advertising on Airways

ENTIRELY fresh outlets for enterprises are becoming somewhat rare nowadays. All likely ground has been gone over so minutely that the discovery of a new pasture is something of an event. It is this fact that lends interest to the quite new idea of advertising on airways.

Thousands of people have this summer passed by way of the air between London and the Continent, and there will be many thousands more during this next year. Traffic is expected, in fact, to be quite trebled in volume. These air travelers are people to whom "time is money," people of discrimination, people to whom the shrewd advertiser would naturally turn. And as the "air age" we are now entering is likely also to be an age in which an even greater use is made of skilful advertising, any scheme which can, so to say, bring these two great ideas together will very clearly merit attention.

If one wants to advertise on an air way where is the advertisement to be placed? It is clear that it cannot be put just anywhere one likes. There is the case already of one very enterprising but rather too precipitate concern which not long ago went to the trouble of painting a striking word on the roof of a building at one of the air ports. The company was much annoyed when the flying authorities stepped in and politely but firmly demanded the sign's removal. The reason for the request was simple. On one fringe of the landing ground, in large white letters capable of being read high in the air, the name of the air port had been placed, and it was specially necessary that there should be no confusion or any possibility of a mistake on the part of a descending airman as to the identity of the port he was approaching. It was thought that some foreign pilot, gliding down and seeing a large word painted on the roof of a building, might mistake the advertiser's announcement for the name of the port and wonder where he was.

One mentions such a point because it shows that nothing must be done that will clash with official guiding sign, nor may one send up kites or captive balloons, because the cables holding them might be fouled by aircraft.

So long as an advertisement does not conflict with traffic control the field is very wide and interesting. Schemes are in hand already for specially designed advertisements placed on the ground in the neighborhood of prominent air stations, while advertisers are also turning an eye to those points on the British and French coasts which pilots cross over daily on their way to and from Paris, Brussels, and Amsterdam. An advertisement which attracts the attention of an air traveler as he passes over England on a flight from the Continent is obviously good publicity.

While it is true that the airway is tied to no particular route as is a railway, it is equally true that the regular navigation of machines between two such cities as Paris and London does as a matter of routine, bring craft daily over almost identically the same tract of country. It is therefore perfectly feasible to take a map and say that if an advertisement is placed in a certain spot it will be on the line of air traffic.

It might be thought, perhaps, that airplanes fly so high that any ground advertisement would be rather a doubtful investment measured by the number of persons in the air who would actually catch sight of it, but from the normal cruising height of a Continental passenger airplane it should be perfectly easy to see and read a ground sign which is sufficiently large and has been designed to serve its specific purpose. Advertising position not far from air ports will no doubt be most sought after, because the altitude of machines will be reduced while they are ascending or when preparing to alight.

The aerial advertiser must tell his story in a very few words. One word, or perhaps two or three, will be all he can allow himself. Abroad, and more especially in America, the idea of aerial advertising is already attracting a good deal of attention. In New York, for example, there is at least one organization which specializes in this work. Over here, however, the advertiser has to remember that the air authorities, while quite sympathetic toward anything that is harmless, are at the same time exercising a very rigid and necessary supervision.

Another new field for business men who advertise will come when we have flying by night. This, as a matter of fact, will be the next important stage on the European airway system. Here again, of course, the advertiser will need to conform with the wishes of the authorities in regard to preventing his sign from clashing with any purely navigation light, but there should be no difficulty if common sense is used. There will be whole stretches of country, both here and abroad, over which aircraft will be passing in increasing numbers, and on which the advertiser will be able to place some illuminated sign so devised as to rivet the roving gaze of night travelers by air.

Apart from announcements on the earth on which voyagers look down from the air, there is the question of having an advertisement on an aircraft in flight so that those who remain on the earth may see and read it as the machine passes overhead. Here, at present, the smallness of commercial airplanes in use introduces a factor which is temporarily adverse. There is the point, furthermore, that the registration number has to be displayed prominently on each machine, which leaves less scope for advertising than would otherwise be the case.

Where a field should lie, however is in connection with large commercial airships. There will be ample space on their big hulls for advertising, and it may be assumed that companies operating them would not be adverse to obtaining revenue in this way, always granted that the advertisements are in good taste and placed on the hull with an eye to avoid ing the incongruous.

Modern Research in an Ancient Industry

THE National Research Council and the American Ceramic Society have established a joint committee for promoting the investigation of scientific problems underlying the ceramic industry, especially by founding a series of research fellowships whose holders shall devote their attention exclusively to these problems.

The ceramic industries, including brick and tile making, and general crockery and glass manufacture as well as ornamental potteries, although among the earliest ones developed by man, have been the last of our great manufacturing industries to reach the status of an applied science. They have been based for centuries on rule-of thumb methods, trade secrets and individual artistry. As far as their artistic features go science can do little or nothing for them, but in all other ways it can be of great advantage to them.

In sharp contrast to the painfully slow development of these ancient industries is the extraordinarily swift development of such exclusively modern industries as those of synthetic dyes and others entirely based on the discoveries of modern science. The startling success and speed of growth of these are almost entirely the fruit of highly organized scientific research, with methods of scientific control at young stage of the operations. A famous English scientist is authority for the statement that the capital, large as it has been which the German dye firms have invested in scientific research has been the best-paying investment which the world has ever seen. It is certain that an organized effort to develop the fundamental science of ceramics can have a great influence in advancing the industry.

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IN THIS ISSUE

HOME BUILDING SIMPLIFIED
WHAT ARE VITAMINES?

SCIENTIFIC AMERICAN

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RAISING A STEEL TOWER INTO PLACE FOR AN ELECTRIC TRANSMISSION LINE.—[See page 84]

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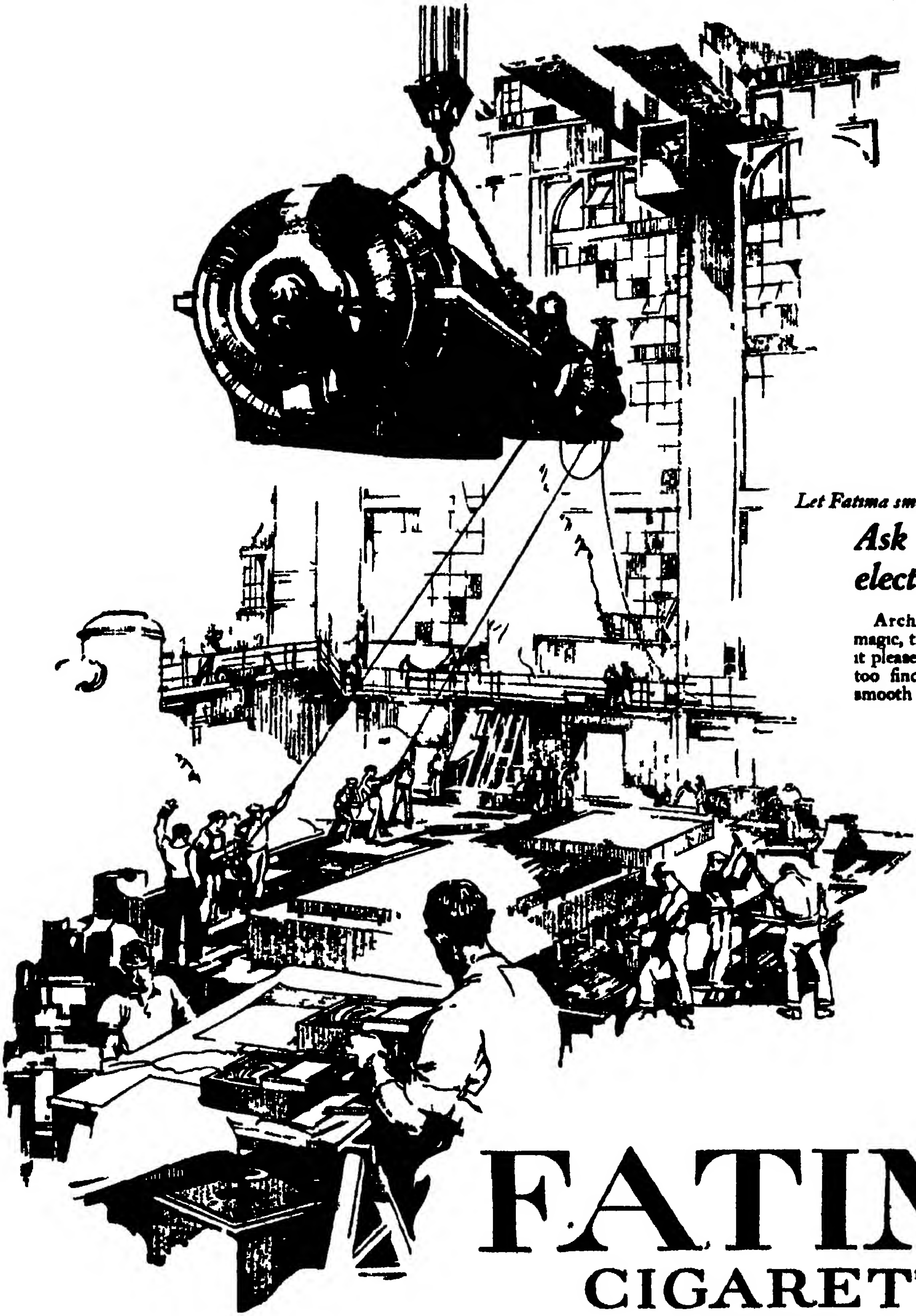

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SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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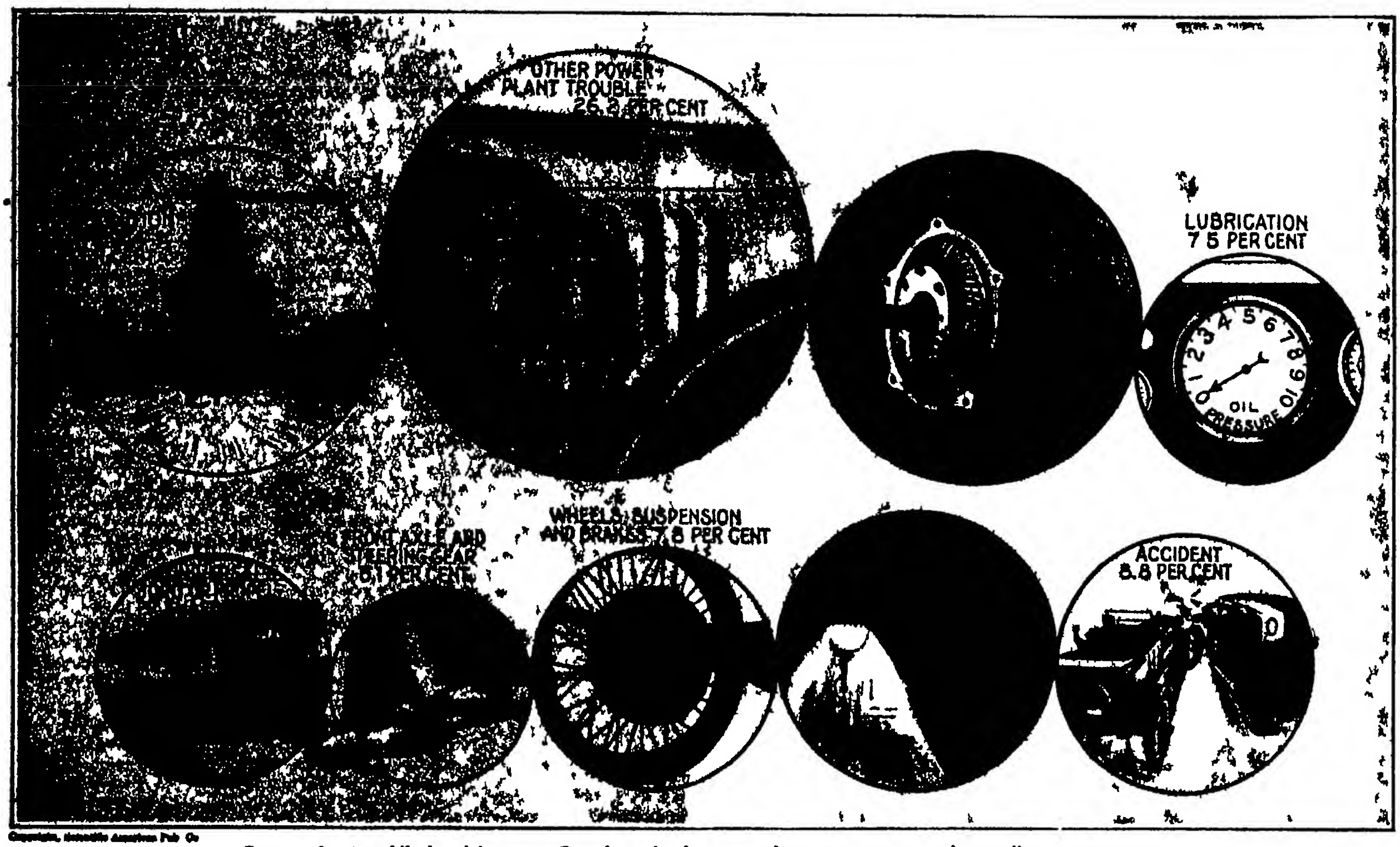

Causes of automobile breakdowns on British roads shown in relative proportions and according to percentages

British Roadside Breakdowns

THE Royal Automobile Club of England has for some years maintained a flying squadron of trouble chasers who go to the rescue of members stranded on the roads with a machine that cannot be made to do its duty. The activities of these service men over a considerable period have just been collected into a report from which are compiled figures showing the various causes of disabling breakdowns. Tire trouble and the minor ills that the motorist corrects for himself are of course not included; only those breakdowns are reported which were beyond the motorist's ability to effect temporary repairs.

It will be seen from the graphic chart on this page that [illegible] per cent of the crippled cars result from power-plant and transmission troubles, and 31.5 per cent from failure of some subsidiary feature of the car. It stands to reason that in the great majority of cases where a car is incapacitated the trouble is due to the refusal of the motor to furnish power or to the impossibility of delivering its power to the rear wheels. Of the specific items, first place is disputed between the ignition system and the rear axle. 134 cars out of every 2000 that have to send for assistance at the roadside owe their troubles to the failure of the spark, and 139 [illegible] are unable to run because of breakdown in the [illegible] that carries the power from the propeller shaft to the wheels. Further localization of power-plant difficulties shows that 7½ per cent of the emergency calls are in response to lubrication systems that have refused to lubricate, and that another 7[illegible] per cent owe their origin to difficulties in the universal joint or propeller shaft—parts which by virtue of their comparative inaccessibility and immunity from the necessity for ordinary adjustment are perhaps more of a sealed book to the average driver than any other region of the car. Then there is a large 26.2 per cent of breakdowns that are attributed to unclassified difficulties with the power plant. Under this head we may visualize broken crankshafts, connecting rods loose beyond the point of toleration, valve failure, etc. Doubtless a carburetor blown out by back fire would come under this head; and since there is no other place for it, we suspect that a car compelled to lay up for want of water circulation would be considered a power plant casualty. It would be interesting to have this item further analyzed, but we can only present the figures as they come to us. The heavy toll of rear axle trouble, it is suggested, is probably due in large part to wheels that were loose on the driving shafts causing a play that resulted in breakage.

Passing from the power plant, it appears that the heaviest demands upon the emergency squad are made by the failure of the lighting system at night. For practically eleven per cent of all crippled cars to be attributable to this cause seems very high, and leads us to wonder whether the flashlight is in such common use in Great Britain as it is here, and whether British cars are so generally equipped with a reliable battery and generator. In this respect at least we are sure that these figures would not be valid for American motoring.

On the other hand, the British driver must be constitutionally a more cautious species than his American brother if he is able to show that only 8.8 per cent of his crippled cars owe their troubles to accident. The average American driver, we believe, could achieve this result all by himself with the aid of sharp curves and fair roads, without calling into play at all the services of other drivers to run into him or crowd him into the ditch. Of course the universal severity and rigid enforcement of traffic laws in the United Kingdom may have something to do with it, and we rather suspect that a large contribution as any to the result may be seen in the pleasant British custom of endorsing on the motorist's license every little thing that ever happens to him from the time he leaves his garage until he is safely under roof again.

The tale of the British car driver's woes is completed by the statement that 7.8 per cent of them are caused by failure of the brakes, of the suspension, and of the wheels themselves as distinct from axles, etc., while the remaining 5.1 per cent are laid at the door of the front axle and the steering gear.

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On the Trail of the News

DECEMBER 24, 1814, saw the signing of the Treaty of Ghent bringing to an end the farcical conflict known in this country as the War of 1812, and having hardly a name of its own to distinguish it in the British mind from the generality of the Napoleonic Wars. On January 8, 1815, fifteen days after the diplomats had reached agreement on the questions at issue, the most spectacular land battle of the war was fought at New Orleans. Presumably, had there been any way of doing so, the respective governments would have notified Generals Jackson and Pakenham of a state of armistice But the contending armies were not alone in their ignorance of passing events, the public of Britain and America were in equal darkness

The events of July 2, 1921, at and around Thirty Acres, Jersey City afford a striking contrast The sporting interest always inherent in a championship contest of any sort reaches its culmination in a heavy weight boxing match In the bargain there was the international character of the Dempsey Carpentier melee, which was further heightened by the exuberance with which the entire French nation threw itself into the business of rooting for its champion Finally, the bout possessed a sentimental attraction never before seen in such an event, by reason of the general feeling against Dempsey and for Carpentier on the ground of their respective war records

Under these circumstances it is not surprising that the news-gathering agencies were ready to outdo themselves in their efforts to report the bout fully and swiftly A brief catalogue of the instrumentalities employed in this service will be illuminating First place must go to the wireless telephone A complete "punch by punch" summary of the fight was sent over the ether from the arena, so that anybody, anywhere, within a range of many hundreds of miles, needed only a receiving set to keep himself better informed of the progress of the fight than the occupants of the more remote seats For those lacking such sets, or lacking the ability to use them there were, in every large town and in hundreds of small ones, bulletin boards on a more or less ambitious scale on which the telephonic reports were posted Columbia Pa is by no means a metropolis, yet in driving through this town on the afternoon of the fight we paused to watch on such a board what proved to be the final round The French craving for the fullest and promptest account was satisfied by wireless and cable and in the bargain the large photographic agencies at the ringside made duplicate exposures, and delivered one set of undeveloped negatives, by airplane, aboard a ship that had sailed from New York four hours before the first punch—thus avoiding a wait of two days or more A British illustrated journal arranged for the transmission of pictures of the critical moments of the fight using the cables in connection with the well known half tone analysis of the original We are not at the moment informed of the operative details or the extent to which the scheme was successful, but there is of course no reason why it should not give satisfaction Finally, there was the usual army of special correspondents, equipped with telegraph and telephone and charged with the thankless duty of getting every move over the wire before it happened In this connection it may be in order to mention one of our good friends who has been reporting the World's Series baseball games for his organization for fifteen years and who is so good at this business of getting the play on the wire while it is being made that in cities where there are adjoining bulletins, one fed from his wire and one from a competing service, he is always five seconds or more ahead of the other fellow

It seems at first blush a trifle deplorable that such marvelous reportorial ingenuity and skill should be lavished mainly on sporting events. The answer is after all reassuring Sporting events come off on schedule, wars and fires and murders and wrecks do not. If they did, we might be sure that the same means employed in the filling of the sporting pages and the flashing of the sporting bulletins would be employed with equal freedom on the world's more serious business To whatever extent they are applicable they are so employed, and the methods themselves are a great tribute to the enterprise as well as to the technical skill of the present generation

Doing Instead of Talking

THE literature that has been devoted to lamenting the waste of power resources in the shape of coal, oil and gas, and to pointing out how this waste might be prevented would easily paper the walls of all the buildings in the United States. What is perhaps more to the point, the paper that has been wasted in unheeded sermons on the subject of fuel economy would, if stoked under steam boilers, go a long way toward relieving the present alarming shortage of mechanical power throughout the world

During the last four years the price of coal has more than doubled in this country During the same period an immense amount of publicity has been given to methods whereby a stated amount of coal can be made to yield more power and other service The general application of these methods would have mitigated the burden arising from the increase in coal price, or, more probably, it would have diminished the demand for coal to such an extent as to prevent any material increase in prices Unfortunately nothing of the sort has happened Intelligent economics in the use of coal are still the exception Colossal waste is still the rule

How long is this paradox to continue? How soon shall we stop preaching fuel economy and begin practicing it? Cheap mechanical power is the greatest material need of the human race at this moment. It would set to work the idle factories and the millions of idle laborers. It would abolish the high cost of living And it is perfectly attainable by the application of knowledge now in the possession of engineers

Here and there pioneers have set the example which all must eventually follow Two or three coal mines have been equipped to distribute their output in the shape of electricity instead of coal Why are there not such mines in all parts of the country where deposits of coal occur within a couple of hundred miles of a profitable market for power? The present practice of shipping coal from a mine by rail to points within range of electrical transmission is the height of grotesque absurdity A coal mine is exactly as logical a place to generate electricity as a waterfall The intervention of the railroads with their high freight rates and notoriously inadequate service, is the greatest single factor in making electrical power expensive The erection, on a general scale, of central power plants at the mouths of coal mines is capable of revolutionizing the industrial life of this country

What is true of electricity is likewise true of gas. The natural gas industry has fully developed the technique of distributing gas to points hundreds of miles distant from the place of production Now that the supply of natural gas is on the verge of exhaustion it is high time for the coal mines to take up the task of the expiring gas wells, to generate gas at the mine mouth, and supply it for industrial and domestic use in the surrounding regions. Here again is an opportunity for the coal operators to serve their country and their own pocketbooks at one and the same time

Prevailing methods of burning coal are a full generation behind sound theories on the subject. It appears to be well established that vast economies both in labor and heat units can be effected by reducing coal to a pulverized or so-called "atomized" form before it is burned It is encouraging to learn that fifteen million tons of coal was pulverized in the United States last year But it is discouraging to reflect that this amount was less than three per cent of the total coal production of the country

The Paradox of Civilization

IF we ask whether a man can be over-civilized, the answer depends, no doubt, largely upon the bias of the individual passing judgment. Still more, however, it depends on circumstance. Over-civilized—over-civilized for what? A bookkeeper in a New York office is a very useful member of society. He is probably the last man against whom any of us would bring the accusation which we are discussing. But let chance—a shipwreck for example—completely isolate him from his fellows, and in most cases he will be quite unable to meet the new situation, which to a savage in the jungle might present no particularly difficult problems

This is the paradox of civilization that the more perfect the more refined the methods employed by man to wage the struggle for existence, the more helpless does the isolated individual become. Think only how embarrassed you would be, especially on the advent of winter, if you should be unable to procure so simple a thing as a match This, of course, is the time-honored lesson of all Robinsonades, but it is worth while to give it another thought in this year of grace 1921 For it exemplifies certain significant biological facts and principles. The record in the rock tells us how the races that have succumbed in the struggle and have passed from the face of the earth are not so much the simple, lowly, imperfect forms, but in many cases represent the last, seemingly most perfect link in an ascending chain of progeny The grounds for this may be sought in a variety of circumstances. Some biologists incline to the view that the development of a race is determined almost wholly by inherent tendencies, that the race is born, grows to a certain form, and ultimately ages and dies, much as is the case with the individual.

But another view equally competent to account for the facts, is that the races of organisms became, through a process of survival of the fittest (out of a varied assortment of progeny presented for selection) more and more adapted to existing circumstances, which thus molded the surviving species of the period, as we see them in life about us, or as they have been preserved for us in the fossils of the age

And, as long as the circumstances thus molding the plant and animal population of this globe remained approximately constant, all was well, the molding process continued in the same direction toward ever more perfect adaptation to existing conditions. But suddenly (geologically speaking) came a change, in climate or in some other condition closely bearing upon life It was then as if the course of the runners in a race had been suddenly reversed, the first becoming last, and the last finding themselves now in the lead For adaptation is a relative term In proportion as a species had become highly adapted to the long-continued old order of things, in like proportion was it unfitted to conform to changed circumstance. Nature has her own way of condemning the over-conservative, and, in her characteristic pitiless fashion, she punishes failure with annihilation

Can man be over-civilized?

In the recent past the evolution of our race has been, not so much the development of the individual as that of society, of the organization of men and machines, which work in unison to maintain our complex modern industrial life The individual, today, is probably little different, anatomically and physiologically, from what he was five thousand years ago. But the social organism is radically changed Evolution has proceeded, in this respect, at a speed which mocks all comparison with any of her previous performances.

But let man beware! The time of his prosperity is his hour of danger! Take stock and count the cost! We have been living on our capital. A few hundred, or at most a few thousand years, and our dwindling coal supply will be wholly spent. When that day comes, the barbarian, the savage (if such there be), innocent, and therefore independent of our "modern improvements," may lead in the death race with the ebbing tide

Unless—unless man proves the exception to the biological rule, as he may For what species, in all the world's long history, foresaw the danger a thousand years before its onset?

Electricity

Prof. F. B. Crocker.—It is with deep sorrow that we have to note the passing away of Prof Francis Bacon Crocker, founder and Vice-President of the Crocker Wheeler Electric Company at Ampere, N J., and for many years head of the Department of Electrical Engineering at Columbia University Prof Crocker, who was unmarried, was sixty years of age

Basalt as Electrical Insulator.—Research made during the last few years has shown that basalt, which has a very good insulating property, can be practically cast. It can thus be employed for the manufacture of insulators possessing distinct advantages over those made of glass or porcelain The enormous dielectric resistance of basalt points to extensive use of such insulators in the applications of electricity

Mercury Vapor Rectifying Valves, according to H Giron, writing in *Revue Generale de l'Electricite*, possess a well-known ability to rectify currents. The high intensity mercury vapor valve, however, which is capable of coping with an output of from 200 to 1000 amperes per valve, is not yet of general use in electrical practice It is almost certain that the mercury vapor rectifying valve will be put to considerable use in the no distant future, even in large units.

With a One-Meter Loop Antenna and a special twelve-tube receiving set, remarkable results have been obtained of late in Paris. Even transmitters of low power have been heard some 5000 miles away under conditions by no means ideal In fact, messages have been recorded on photographic tape at times when commercial radio companies were greatly troubled with static The twelve tubes employed for the receiver serve to detect, amplify and even filter the signals so that static and other parasitic disturbances are weeded out

Aluminum for Electric Bus Bars.—A British aluminium company has just issued literature dealing with the use of aluminium for bus bars and interconnections in electric power stations, in which it claims that aluminum secures a more complete economy than the substitution of bare copper rod or bar for insulated cable It claims that the use of aluminum results in considerably reduced initial costs, greater ease in erection smaller temperature rise for equal inductance, and less weight, also slower temperature rise under temporary heavy increases of load and greater resistance to corrosion

Large Mercury-Vapor Rectifiers.—After discussing the electrical arrangements of large mercury vapor rectifiers, a German writer in a German periodical refers to the advantages of this type of rectifier and especially its high efficiency He also refers to the satisfactory experience with the mercury vapor rectifier, which demonstrates that the modern type in which the earlier defects have been eliminated is as certain in working as all other types of rectifiers Furthermore the mercury vapor rectifier possesses quite a number of valuable characteristics which seem to render it superior to the usual type of rotary converter It is believed that there is a brilliant future for this form of electrical equipment

Four-Electrode Vacuum Tube.—In a recent paper by Prof J A. Flemming, read before the Wireless Society of London, there is described the new Flemming four-electrode tube which can be used as a detector of damped or continuous waves In these tubes instead of a grid intercepting the stream of electrons from the cathode there are provided two "potential plates," one on each side, which deflect the stream when their potential is altered by a received oscillation This causes a variation of the thermionic current which, in the case of damped trains of waves, is audible in a telephone. In the case of continuous waves, this reduction of current can be made to cause a delicate relay to drop off while the waves are being received

A New Arc System of Welding is now being employed by several companies who report that it effects maximum savings in the cost and time of manufacture and repair of metal parts. Uniform success is said to attend the welding of metals of various characteristics, such as cast, malleable and wrought iron cast and rolled steel, bronze and brass, etc The new system is the only one, so it is claimed, producing constant heat per unit area in the weld due to the following points 1 A limited low voltage output from the generator which prevents injury from high voltage and assures a short arc 2. Maintained constant current supply to the welder The current flowing through the electrode is the same whether the current is short-circuited or flowing in the form of an electric arc. 3. Welding metals so designed that they furnish the required ductibility and tensile strength within practical limits of metallurgy.

Science

MacMillan Starts for Arctic Regions.—Donald B. MacMillan started as arranged for, for the Arctic regions in the small schooner "Bowdoin on July 16 from Wiscasset, Me.

News Print From Waste.—A paper mill approaching completion in Chicago is to manufacture newsprint from waste paper under an entirely new process. The mill is expected to produce from 10,000 to 15,000 tons of newsprint annually

Cleaner Money Coming —The Secretary of the Treasury promises that soon cleaner money will be in circulation This is devoutly to be wished for, as the dirty, insanitary ill smelling money which has been in use for the last five years has been disgraceful Of course the fault does not lie with the government officials, as the Bureau of Engraving and Printing is not elastic, and has been greatly overburdened in the production of bonds and other public debt securities.

Shark Fisheries.—The fins are usually sold for consumption by Chinese but we have ourselves eaten shark fins 'Newburg" which was a delicious dish Each liver gives about a gallon of oil and is used as a preservative for leather and for a vehicle for paint The meat is used for chicken feed or as a fertilizer and the skins afford a source for aquatic leather Shark steaks are sometimes served in the Chinese quarters of our Pacific Coast City under the name if name is given at all, of "grayfish'

Ban on the Poppy.—The bright red poppies of Flanders fields are not welcome in Massachusetts. The Commissioner of Agriculture Arthur W Gilbert, in urging that no more seeds or plants of this variety be brought to this state for propagation purposes, asserted that the growing of the flowers here might result in tremendous loss in agricultural districts. The Flanders poppy, according to the Commissioner, spreads very rapidly the seeds being carried by the wind, and there would be great danger of damage to crops

St Swithin Discredited.—The recent deluge of rain which was so welcome hereabouts has brought up the old story of the traditional forty days of rain which should ensue, but unfortunately this old saw is not a very reliable one In the first place St Swithin was not a saint at all, having never been canonized He was only a plain bishop of Manchester from 852 to 862 The weather bureau statistics also show that in many cases St Swithin can only be credited with nine days rain instead of the regulation 40 days.

Japanese Beetles Imported to Destroy Insects.—Five thousand beetles have been imported from Japan to fight a pest of destructive leaf-eating beetles in the Eastern States where they have done great damage to truck gardens. The beetles which have been imported are of a particularly ferocious variety and it is expected that they will make short work of our domestic beetles which are so destructive to the crops. This particular beetle has been shipped to the United States before, but never in very large numbers. It is expected that a much larger shipment will be made in the near future

Longevity of the Eiffel Tower.—M Eiffel, who is now 89 years old has a small apartment on the highest platform of the tower which he built, so that he has been comparatively free from the discomfort caused by the recent heat waves which the Parisians have not been enjoying Every precaution is taken to prevent rust and M Eiffel considers that the structure has a practically indefinite life The Eiffel tower was erected over thirty years ago at a cost of $1,800,000 This remarkable structure was built in 25 months and weighs 15,000,000 pounds. There are more than 15,000 separate pieces in the tower which are held together by 2,500,000 rivets. Of course the tower could not be built today for several times this amount

Paying Fines As You Go.—Some useful things have occasionally come out of the turmoil in Central Europe One of the best plans of which we have heard is a new fining system which is used in Prague The police carry receipts for fines for various sums in their pockets, and present them for immediate payment to hilarious citizens who break the peace by singing or playing on musical instruments on the streets at the wrong time, or where the volume of harmony is too great This tends to allow the citizens of this old city to get some much needed rest This system has worked so well and has become so popular that it was extended to traffic violations as well It would certainly be a great convenience if we could adjust minor infractions such as a smoking automobile, our failure to keep automobile lamps lighted, without having recourse to the police or traffic courts.

Engineering

Concrete House Building in Australia.—The use of concrete in cottage building was recently successfully introduced in Sydney, when it was demonstrated that a better construction, at a cost 25 per cent cheaper than brickwork could be obtained It is believed that the uses to which concrete may be advantageously put in Australia are manifold, if cement can be plentifully obtained.

Tidal Power.— In a recent issue of *Engineer*, there appears an analysis of the various methods of using tidal power, in which the author, Norman Davey, considers (1) Single basin systems subdivided into (*a*) outward flow type, (*b*) inward flow type, (*c*) outward and inward flow type and (2) two-basin systems consisting of (*a*) double basin type, (*b*) sump type All these systems are of the water storage type The float system is dismissed as having only theoretical interest, being a producer of small power only

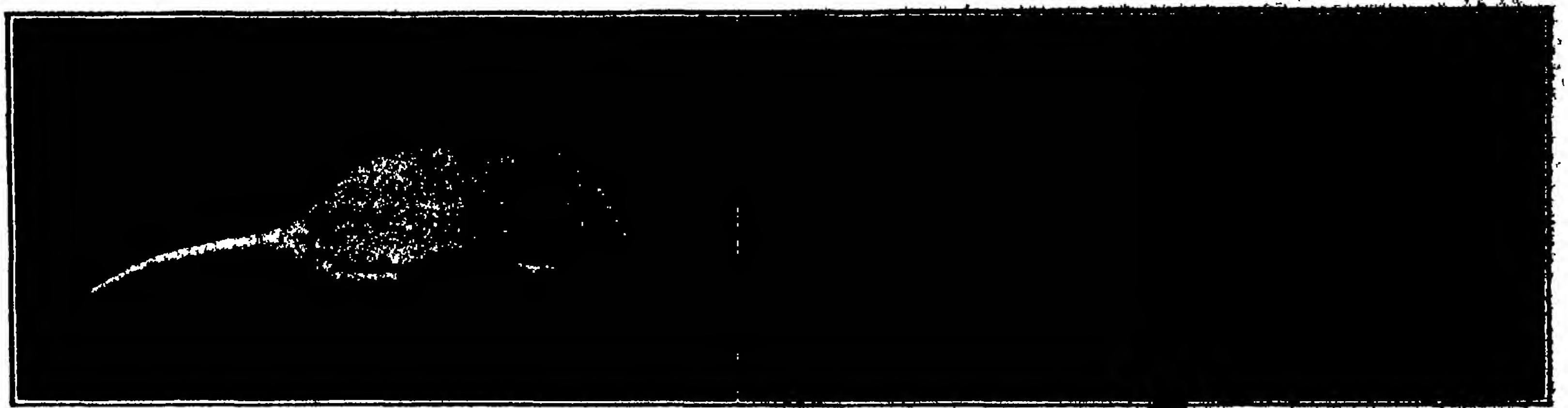
German Nickel-Chrome Steel Bridge —From the *Krupp'sche Monatshefte* it is learned that the Germans constructed a bridge of nickel chrome steel instead of mild steel, some nine years ago This bridge has been in constant use and has proved satisfactory, no repairs having been necessary The nickel chrome steel used has thus fulfilled expectations, and proved to be a suitable material in cases in which low weight without loss of safety is essential The bridge is a single track railroad bridge, the main girders, which are of nickel chrome steel weighing 35 per cent less than if mild steel had been used

A Movable Dam is a feature of the hydro-electric installation at Boffeto to supply electrical energy to factories at Sesto near Milan, in Italy This dam, we learn from *La Vie Technique et Industrielle* does not alter the bed of the River Adda, and ensures at the same time in a safe and rapid manner the passage of torrential floods which are particularly swift and violent in this district One or more sections of the dam can be raised or lowered individually as required, according to the state of the river but in case of an unforseen flood the entire barrier can, by a system of racks and capstans, be raised simultaneously

New Passenger Landing Stage.—The Port of London authority, the city department which owns and controls most of the London docks, has announced the prospective construction at Tilbury of an ocean passenger landing stage This is to be of the floating type, 1700 feet long, 80 feet wide, and 40 feet deep below low water ordinary spring tides so that the largest vessel afloat can be accommodated alongside at all stages of the tide It will be equipped with the most up-to-date appliances for the handling of passengers' luggage, and customs examination will take place in a hall which will be constructed alongside. The landing stage will be connected by a bridge to the railway station

Power from Glacier.—On account of the scarcity of water power in the Bern district of Switzerland, it is proposed to utilize the water from the glaciers in a systematic manner The Bachilis Glacier is the first one selected and by closing the natural drainage and constructing a masonry dam, the engineers are to form a storage reservoir of 113,000,000 cubic feet capacity Water will then flow from the reservoir to Lake Grimel, which upon the completion of the new dam 492 feet long 325 feet high by 262 feet wide at the base and 12 feet 6 inches wide at the top, becomes the main storage basin for the entire installation Two new power stations are to be constructed, developing 120,000 horsepower in one and 90,000 horsepower in the other

Canalization of the Rhine.—Under the Treaty of Versailles, France is granted the exclusive right of the exploitation of the Rhine from Bâle to Lauterburg, and she claims to dispose of the river as she would of any purely French waterway such as the Rhone, the Loire, etc That portion between Bâle and Strasbourg, we learn from *The Technical Review* it is proposed to sacrifice as a navigable waterway and to substitute a canal some 80 miles long with numerous locks. The aim is said to be to favor exclusively the Alsatian-French canal system the Atlantic and Mediterranean ports of France, the agriculture of Alsace (through irrigation from the Rhine) and Alsatian French industry (through hydropower stations to be established on the closed part of the Rhine) An engineer has entered a plea for the abandonment of this scheme, showing how the canal would seriously limit the tonnage reaching Bâle, involving the transfer of cargo from ships to barges for the passage of the canal He claims that the required water power could be obtained without closing the river



This rat has been fed on standard bread. The lack of vitamines has a marked effect as shown in this rat, pictured as it was in the first week and then in the ninth week

What Are Vitamines?

Studies and Experiments Which Cast Some Light on These Mysterious Elements of Nutrition

By Harry A. Mount

ONLY in the rarest instances has human life endured beyond the century mark, and the hope that we shall ever be able appreciably to lengthen the maximum span of existence seems somewhat chimerical But a series of recent experiments holds the rather definite promise that such a thing is not impossible, and that we may be enabled to wage such a successful fight against old age that a man will still be 'young' and virile at a hundred The agency which promises this miracle is the mysterious food element which scientists have named "vitamines."

Another remarkable group of experiments is being conducted at the Rockefeller Institute for Medical Research and elsewhere, as described in a recent issue of this journal, which forms the basis for the conclusion that the tissues of the human body are potentially immortal, or, putting it another way, that barring accidents and disease we ought to live forever

The reason we do not actually live forever is that the organs which compose the complex human mechanism are interdependent, and failure in one, even a minor organ, induces failure in others As time goes on there is produced the phenomenon which we have come to associate with old age, and finally death

It seems that medical science has pretty well accepted the conclusion that the physical wellbeing *of many of these organs is controlled by certain glands*, which have been merely disregarded heretofore because their function was not understood These new experiments indicate that the action of the glands, and consequently many bodily functions, depend in part or entirely upon an element of food, which, although it has not yet been isolated, has been arbitrarily named vitamines

The case against vitamines might well be first considered, for it is based upon the fact that they are mysterious No one has ever seen a vitamine the existence of vitamines has only been surmised from the very definite effects upon the animal organism when lavishly fed with vitamines and when deprived of them

It is a historical fact that men, in their search for new agents which would protect or extend life have often attributed marvelous curative powers to the mysterious. This was not only true of ancient and medieval times when witchcraft and sorcery were thought to be at once the cause and cure of disease, but also in modern times. It was not so long ago that the subject of medical electricity was much discussed and marvelous things were predicted. Electricity has proved very useful and its medical field is being constantly extended, but the hopes of these early experimenters have not been realized So with radium and other curative agents. We ought to be warned in advance, then not to be too hopeful of what the exploration of this new field will reveal

Vitamines are the elements in food which are apparently vital to certain functions of the body, necessary to human—or animal—existence Hence the name

The existence of vitamines was first definitely established during the Russo-Japanese War Large numbers of Japanese troops, subsisting largely on a diet of polished rice, developed a disease called beri-beri, similar to scurvy Considerable experimentation showed that an effective remedy was the feeding of a small quantity of the rice polishings From this it was inferred that there was some vital element in the surface of the rice grain Further experiment showed this vital food element to be present in many other foods, in a greater or less degree, and, in the case of fruits, vegetables and grains, nearly always on the *surface or skin* Thus the bran of wheat, the peel of an orange, and the skin of a potato, are rich in vitamines

It has not been possible to isolate positively these vitamines, and their chemical composition is unknown. It has been possible, however, to prepare concentrates very rich in vitamines and to prepare other foods almost wholly lacking in them By feeding these to various animals and noting the effects, we have succeeded to some extent in furthering our knowledge.

Thus a mouse, given a normal diet but deprived of vitamines, gradually looses its sleek appearance and weight. Certain of the organs, notably the glands, decrease in size and the very nature of the animal changes. A condition of perfect health and vigor can be restored in a few days, however, upon the identical diet, but with the addition of a very small quantity of vitamines.

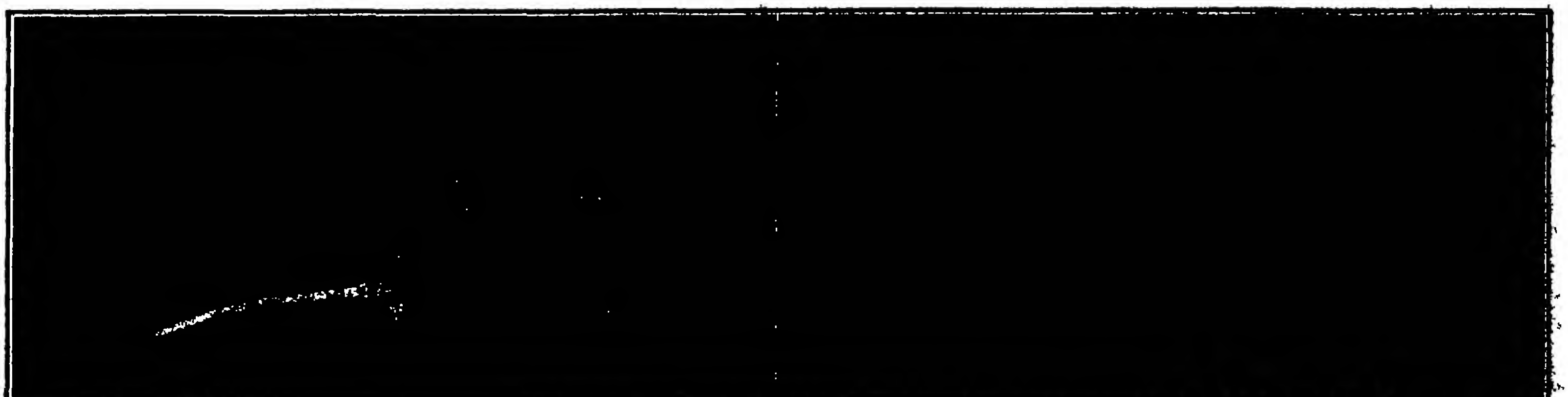
It appears from many experiments along this line that the vitamine bears an intimate relation to the secretive glands of the body, and that these glands, in turn, exercise a decided effect on all the bodily functions.

Recently the world has been startled by the statement of a French scientist that he has succeeded in revitalizing an old man by replacing certain glands with those taken from a young and vigorous animal. A few weeks ago a Washington scientist stated that he had obtained a similar result by stimulating the glands to renewed activity by the application of electrical rays. Still more startling is the claim of another Frenchman to the effect that he has been enabled to change the sex of animals by depriving them of certain food elements, causing the sexual glands and organs to disappear and then, by proper feeding, to cause them to reappear

These things seem quite unreal and impossible to the average person, because they are so far beyond the range of ordinary experience We cannot vouch for these statements, true, but there is undoubtedly some basis of fact. At least, there is a growing conviction among scientists that the glands play a more important part in our earthly existence than we have supposed. Recently medical men of high reputation have advanced *the theory* that the appendix, long considered merely troublesome and useless, is a gland with important functions.

It has been possible, in tests with animals, to accelerate or retard the growth and vigor of any of the glands at will, with very marked results to the whole body From these experiments the vitamines have been divided into three classes called Vitamines A, B, and C. Vitamine A is a fat soluble, such as is obtained from milk, and is remarkable for its effect on the growth and vitality of the sexual glands. Vitamine B is a water soluble, such as is obtained from green vegetables, and appears to be closely associated with growth, especially in young animals. Vitamine C is also a water soluble such as comes from oranges and lemons, and seems to be concerned especially with keeping adult tissues in healthy condition.

(Continued on page 87)



This rat has been fed on bread containing a large measure of yeast. Note the "before" and "after" effects, with nine weeks elapsing between the photographs.

Learning the Truth About Arches

By George H. Dacy

IN the technical language of the scientific engineer and construction expert an arch is ordinarily designated as a statically indeterminate structure of the third degree. Arches are vitally affected by the live loads and heavy burdens to which they are subjected, while in many instances they owe abrupt or gradual deterioration to radical and frequent changes in the temperature and to the settlement of their foundations.

For the most part, little definite data have ever been collected and compiled relative to the deflections which various arches develop under different stress, strain and load. The Austrian Society of Engineers in 1895 conducted the initial series of investigations and studies of the deflections of arches. They experimented with a wide range of arches from short-span brick models to arches that were 75 feet in length, placing extremely heavy loads at various points on the different arches and continuing to increase the load until the arch would fracture or collapse. In every case they measured the vertical deflection of the arch each time after the load was moved or increased. Remarkably valuable results were obtained from this research work to the ultimate improvement of arch construction.

Investigation now in progress at the engineering college of the University of Illinois under the direct supervision of Professor C. A. Ellis is the first attempt of any American institution or engineering society to throw more light on the intricacies and complexities of arch construction and design. These tests are more comprehensive than those attempted by the Austrians, and are to be continued over several years until all possible facts, figures and technical information regarding arches are obtained. At this writing the first experimental arch at the middle western university is being tested. It has been built on the campus near the engineering buildings. It is a 30-foot span arch with a 6-foot rise and is 3 feet thick. It is of reinforced concrete construction, being 6 inches thick at the crown and 15 inches thick at the abutments. It has been reenforced with ten half-inch square rods—five on the top and five at the bottom.

In testing out the strength, service and durability of this arch, the engineering experts make technical computations and ascertain the theoretical stresses and strains which the arch should sustain. Then they make practical application of these theoretical facts. They are endeavoring to establish definitely the truth or fallacy of the three theoretical assumptions which long have been accepted as fundamentals by the engineering fraternity—that in the case of an arch under load: (1) There occurs no change in the length of the span, (2) no change obtains in the elevation of one support with reference to another, and (3) no rotary motion of either abutment ever results. If the practical results show definite deviations from these basic principles of arch construction, the experts are going to [illegible] out the cause and effect of such differences.

In building the concrete test arch, corks, which penetrated to the rod reenforcement, were set in the "green" concrete so that when the material set, these corks could be removed at the will of the [illegible]. Small and minutely uniform holes have been [illegible] at each of these points in the reenforcement. [illegible] of [illegible] are used to [illegible] the length of these holes when the arch is without load. Then, in turn the loads are placed at various positions on the arch and in each case additional readings are made with the strain gages in order to check and estimate accurately any change in the length of these holes that may result from the deflection—if any occurs—of the arch. Electrical thermo-couples are used to ascertain and record any rise of temperature which develops in the arch due to the strain which it experiences under load. *Arrangements have been made so that* temperature readings can be taken simultaneously at 45 different points in the arch. In case extreme rises of temperature are engendered by the introduction of excessive loads the arch will hump up and buckle at the center and perhaps totally collapse.

The investigational arch is also under test for spreading and weakening of the abutments when the loads are increased and applied at different points. Delicate measurements are provided for by means of a graduated horizontal rod encased in metal piping and set between the bases of the two abutments. There are five points on the arch where vertical deflection measurements are taken. As is shown clearly in the accompanying photograph the loads consisting of large slabs of concrete of standardized weight are supported on tables at both ends of an 18-inch steel I-beam. Two jacks are used to raise the beam and its burdens so that the weight of the concrete slabs is transferred to the arch.

The tests will be continued until the arch collapses. Then a new one will be constructed on the basis of the results obtained from the pioneer tests. The work will be repeated until the engineering authorities at the Illinois institution are satisfied that they have solved accurately and conclusively all the practical problems pertaining to arch construction and standardization. In particular it is obvious enough that if the work is carried to a logical conclusion it will lead to the definition of the optimum shape and style of construction for arches, and through this to material increase in economy and efficiency.

Experimental arch and test weights at the University of Illinois, now being used to learn the truth about arch design and construction

A Machine That Clears Away Land

By William Melas

THE increased demand for more land to be put in food crops necessitates the conversion of brush or woodland into agricultural fields. The process of reclaiming land took our forefathers years to accomplish and the progress made in clearing additional area has hardly kept pace with the growing population and demands for more food products.

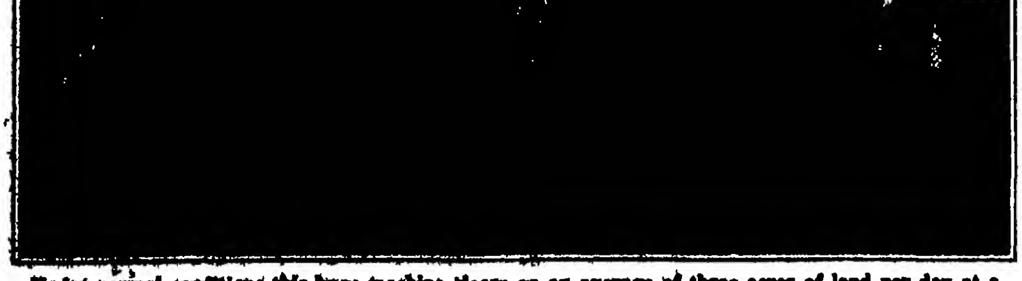
In recent years the question of reclaiming land has received the thought and energy of men in all parts of the country. One of the most striking illustrations of the advanced methods of doing this work is shown below in the view of a new machine which is decidedly out of the ordinary.

Like most modern agricultural machinery this machine is propelled by caterpillar treads smooth enough to prevent injury to roads. Along the front of the machine may be seen a number of bars having teeth cut at their lower ends. When the machine moves forward these bars alternately enter the ground lacerating *the roots and bringing them to the surface where* they are carried clear of the machine by the conveyor belt to be seen in the illustration.

At the back of the machine are two chains carrying sharpened prongs. These pulverize the surface and leave the soil ready for planting. The ground is broken up to a depth of 18 inches. The above operations are all performed at one passage of the machine.

A generator connected to the gasoline motor which propels the machine furnishes current for several flood lights so that work may be carried on at night.

The caterpillar treads are driven separately so that the machine may be easily steered. In recent demonstrations stumps as large as 30 inches in diameter have been excavated. Depending upon the nature of the land an average of three acres per day may be cleared with this machine at a saving of 60 per cent over the present day methods.



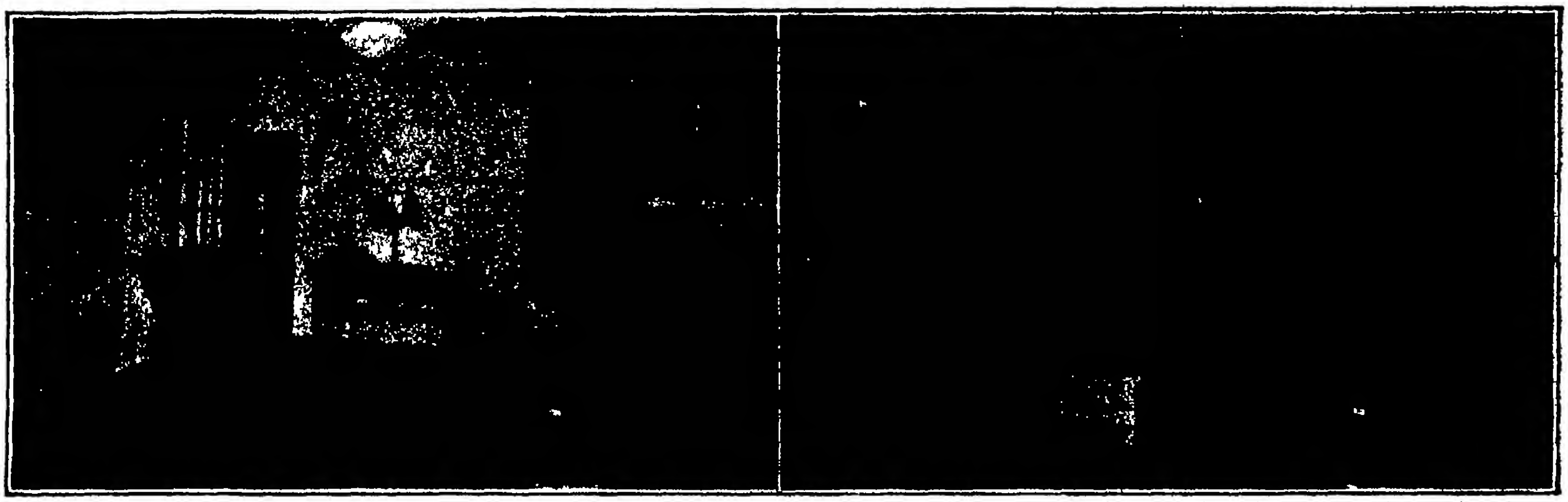
Under normal conditions this huge machine clears on an average of three acres of land per day at a far lower cost than the usual methods

New Varnish That Insulates

A NEW varnish possessing marked insulating properties has been recently placed on the market. According to tests made the varnish after baking possesses a high dielectric strength and electrical resistance, excellent binding and cementing qualities and is practically moisture, acid and alkaline proof. The varnish is not appreciably attacked by sulfuric acid, nitric acid, hydrochloric acid, caustic potash, ammonia, chlorine gas or iodine. The average of all samples tested showed that after 72 hours immersion in water at a temperature of 80 degrees Fahr. the weight of the varnish film had increased by only 0.4 per cent. The 72-hour immersion showed no tendency to soften the varnish film.

The tests made covered the bending of films over a cylinder ⅛ inch in diameter, and investigation of its penetrating power and the stiffening point and the dust-free point in baking and drying experiments and the well-dry and the hard-dry points in matter of time.

As an air-drying varnish, the report enumerates uses to which it is suitable, such as a preventive of corrosion and electrolysis of iron and steel and as a general finish on metal surfaces and a waterproofing material on wood, brick and concrete surfaces. As a matter of fact no such catalogue as this should be necessary to make it plain that a varnish scoring a good showing in all the respects mentioned above will be of material commercial applicability.



The modern living room as seen during the day and at night. The big double bed, with the bedding in place, swings upright and then, on a pivot, swings into the closet

Home Building Simplified

What Inventors Are Doing by Way of Giving the Home Builder More House for Less Money

By M. A. Henry

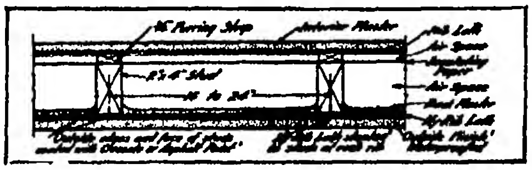
A NEW YORK real estate operator was influenced by the active propaganda for relief from the housing shortage to attempt, not so long ago to help in his small way to provide needed homes. He secured a tract of land desirably located and erected on it a group of six room houses The houses were of substantial construction—not elaborate, but with pleasing detail—and were thoroughly modern, in short they were just the sort of houses that the average American family longs for

In due time they were finished and advertised Many came to see them but few bought The operator was entirely at a loss to know the reason The houses sold for $15000 each at only a fair profit over their cost, they were ideally suited to the average need, the people who came to see them appeared to be the sort of people he expected to find as customers. The operator agreed to carry a good portion of the cost on mortgage What could be the trouble? He asked one of his prospective customers who had just decided 'not to buy at this time, why the prospective customer had reached that decision

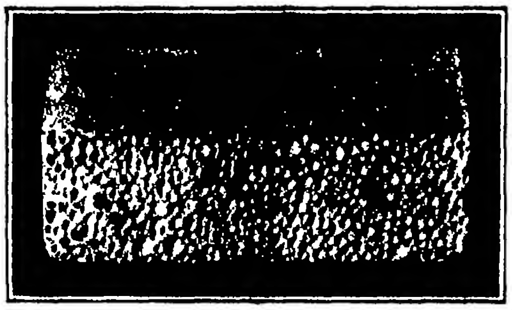
The man took from his pocket an envelope on the back of which he had scratched some figures

"There's the reason you can't sell your houses he said Let me explain In the first place, whether I pay cash or part cash, there is chargeable against my investment at least six per cent interest on $15,000 That is $900 a year Then there are taxes, which at $2.81 per $100 on a valuation of $12 000 is $337 20 There is $25 insurance a year, $150 for coal, $200 for repairs, and figuring the life of the house at 20 years—it would be out-of-date and worth little then even if in good condition—the amortization charge each year is $750 Add it up That's a yearly cost to me of $2,802.20—nearly $200 a month 'rent' or about $33 a room! I can't afford to pay $200 a month rent and I can't afford to buy that house"

And there's the whole 'housing problem" in a nutshell, so far as the individual is concerned. The American family of which the prospective customer was the spokesman six years ago would have thought they required a six room house for comfortable existence. Now they live in "three rooms and bath," and like it! They have a feeling they ought to be paying for their own home instead of "enriching' a landlord like the rest of the sixty per cent of our population, and they are not quite weaned away from the good old days of low building costs.



A form of wall construction which is recommended by the Bureau of Standards

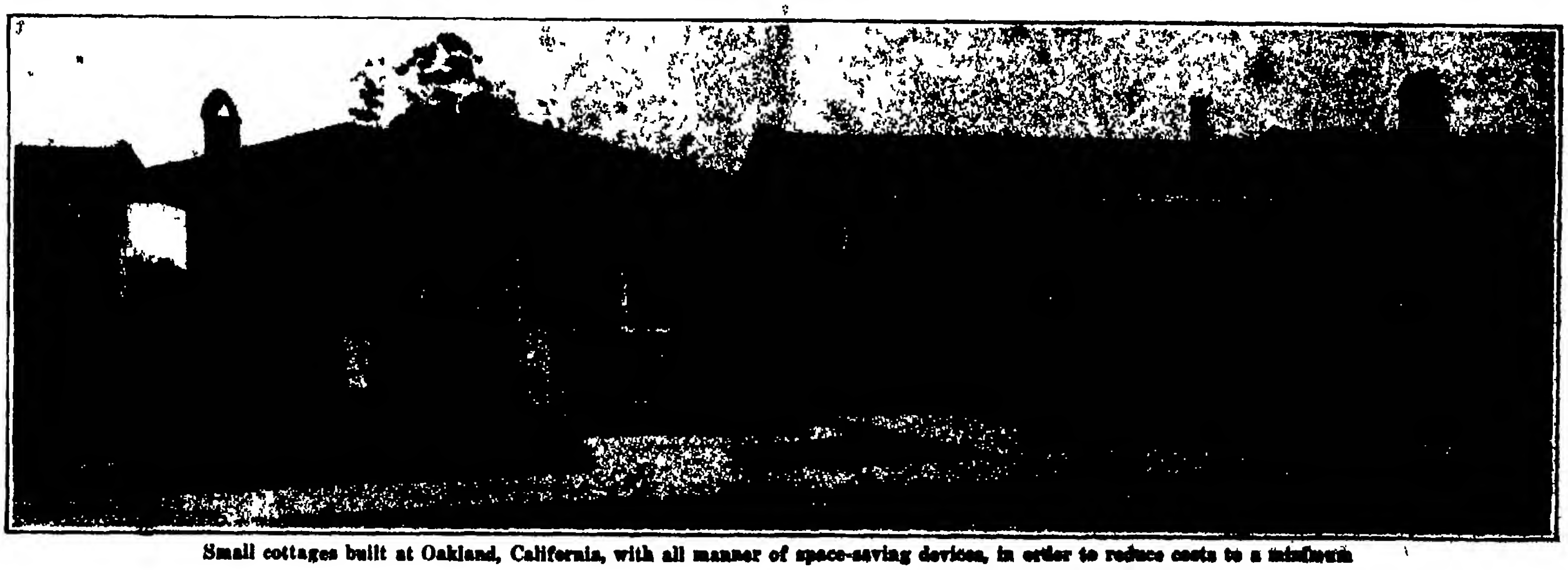


Section of a porous cement slab that is used in much the same manner as wood for outside facings

But as a matter of fact, living conditions have undergone a revolution in the past few years. To be sure there are fewer houses per unit of population than there used to be, and the result is that in many cases two or three families are living where one lived before But the author doubts if we are any less comfortable we are simply learning to use our home space more economically

That state of affairs has led to a real challenge to inventive genius to produce devices which would utilize still more efficiently the space in a small home. Just as any challenge to ingenuity calls forth much wasted effort, so we have been deluged of late with countless housing schemes and devices. A few have stood the test It is the purpose here to show how these are actually changing our former plan of daily existence

Take the case of the man who could not afford a six room home He lives in a three room apartment at just half the cost to him of owning his own home And those three rooms do the duty of six, because no part of the house is allowed to be idle There is a comfortable living room with a fireplace, with no hint throughout the day that the two doors at one side conceal twin beds These beds—full sized, substantial



Small cottages built at Oakland, California, with all manner of space-saving devices, in order to reduce costs to a minimum

and comfortable, fold into an upright position with the bed clothes in place, and swing on pivots into closets behind the doors. They are swung out again and lowered, ready for use, in a few seconds.

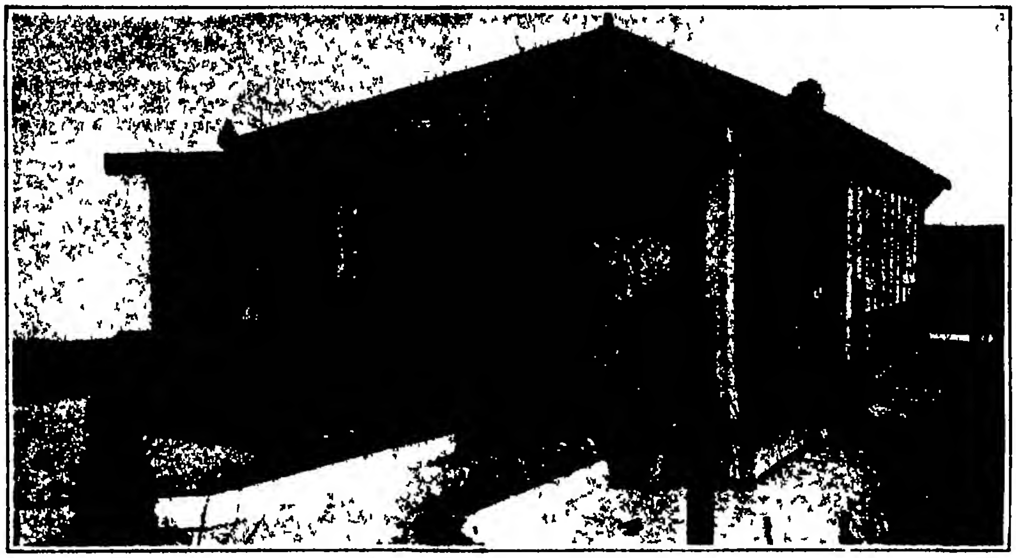
In the dining room another larger bed is concealed in another closet. The kitchen is smaller than our mothers were accustomed to, but is much more conveniently arranged and the housewife's work is considerably easier There is no need for a servant. At one end of the kitchen is a built-in "Pullman" breakfast corner where breakfast and lunch are served at a great saving in labor Father, mother and the children are just as comfortable as ever they were in a six-room house, and the housework is lessened by one-half


A form of construction that is steadily gaining favor: porous cement slabs during construction and as finished

The kitchen arrangement deserves special attention The four-burner gas stove with its oven, the sink, ice chest, cupboards and drawers are all built of steel into one compact unit Mother doesn't have to take a dozen steps to prepare a whole meal. She dumps the garbage into a chute that carries it outside the building

And remember, this is not an isolated instance Thousands of families in our large cities are living in "folding" homes because the same economic conditions which force individual families into smaller quarters, force owners to provide this sort of dwelling. If a man cannot rent an eight-room apartment or house at a profit, he cuts it into two four room apartments and adds the equivalent of two rooms to each by the installation of clever built-in devices.

Many unique space-saving devices are now being used successfully One would think, say, that it would be impossible to reduce the floor area occupied by a 'man sized" bath tub But it has been done by making a deep well in one end of the tub, which is sunk beneath the floor The bather then sits in an upright position, with the water around his shoulders, if he so desires. The deep basin is also useful for a foot bath or a small tub for the use of the children


Fabricated steel house made up of standardized panels, which sells at a low cost and can be added to at any time

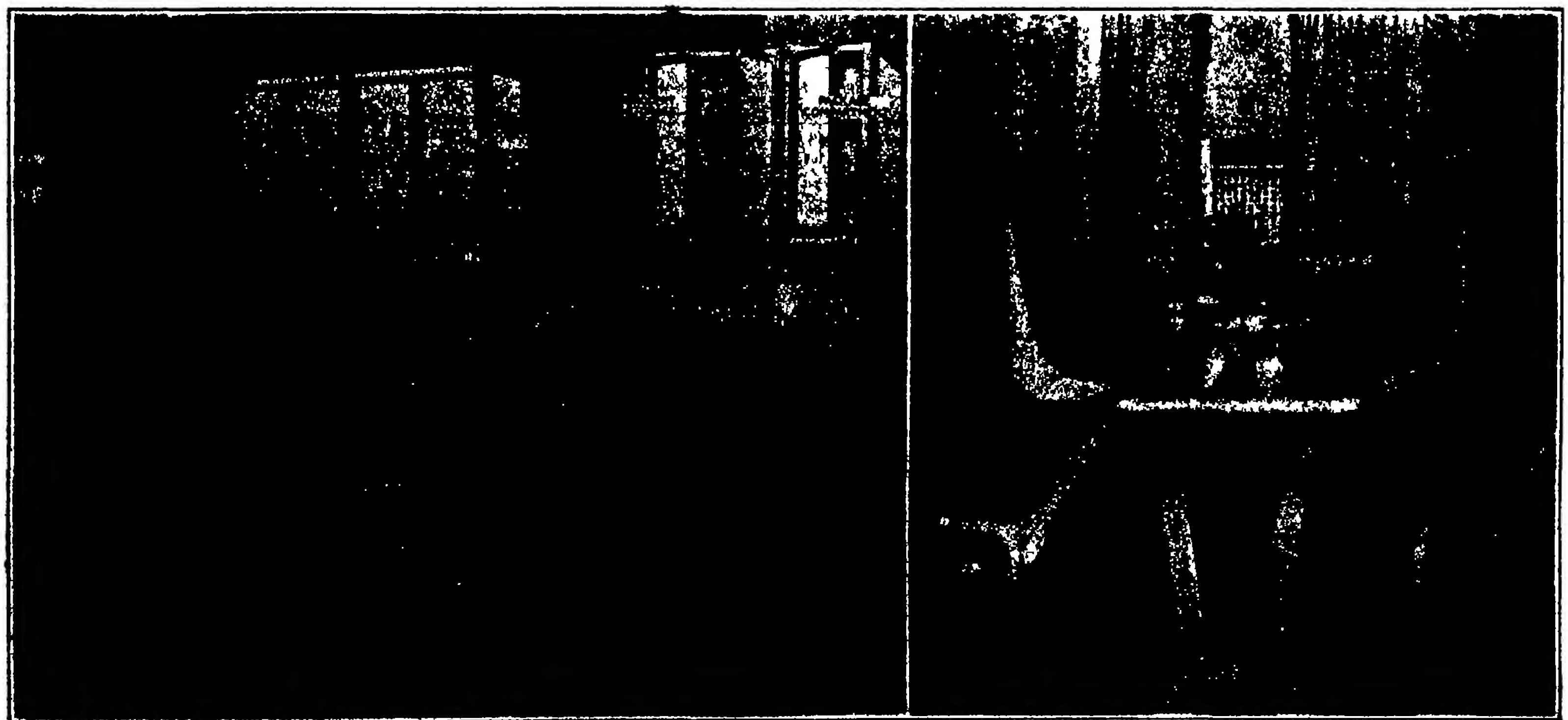
Even the lowly but essential ironing board is built into the wall A long narrow door conceals a shallow alcove in which two ironing boards, a large and a small one stand upright The boards are ready for use simply by pulling them down into a horizontal position

One maker of a famous ready-cut house has just placed on the market a small dwelling which embodies these features and others Fully half of the furniture is 'built in" including a breakfast corner, stove, icebox, cupboards window seats, folding beds, etc

"What we are coming to said William L. Murphy, perhaps the most successful inventor of space-saving devices, and head of a nationwide organization, "is actually a revolution of our ideas of what a home should be And it has taken a mighty upheaval to bring this about People are not easily turned away from the modes of living with which they have grown up

The idea of the small house in which every inch of space is useful, originated, or at least first gained prominence in California where the housing problem is least acute notably in Los Angeles and later San Francisco The idea has moved eastward steadily until it is just gripping the great centers of population in the East Why this should have been I cannot explain It simply happened that the people of the West were more receptive to new building ideas. Stucco, for instance is just gaining prominence as a building material in the East, while in sections of California fully ninety per cent of the buildings are of stucco

'But will people return (*Continued on page 87*)


Left: Complete kitchen unit made of steel and in one piece, comprising stove, sink, dish storage, grocery storage, ice box and so on. *Right* Breakfast and luncheon table and benches for the corner of the kitchen

Tomorrow's Airships

A Survey of What Has Been Done in Commercial Aviation and Its Bearing on the Future

By Major George Whale, Late R.A.F.

THE present age is one of hustle in the endeavor to reconstruct prosperity after the devastating effects of what has been practically a World War. To the man of business, the saving of time means increased profits, and since most of such men spend a considerable portion of their working days in traveling, any means of reducing the hours occupied by their journeys, either over land or across the oceans, will be undoubtedly welcome.

It would appear that we have reached by now almost the maximum speed which can be accomplished over land by the express train, and across the sea by steam ship. There is left only one other means of transport, and that is via air. The two forms of aircraft, the airship and the heavier than air machine, received an enormous impetus from the recognition of their value for war purposes, and reached a state of development in five years which would not have been achieved in twenty in times of peace. Undoubtedly a future exists for both types of aircraft in the realms of commerce, and it is anticipated that the time will come when the airship will usurp the functions of the fast-going ocean steamers, while the airplane will take over the traffic now borne by express trains and fast cross-channel boats. It will be seen, therefore, that the uses of the two types should not conflict, but that each will act as the complement of the other.

Until some entirely new design of airplane has been discovered, it seems fair to assume that no heavier than air machine is capable of undertaking non-stop flights over a distance exceeding 2000 miles, carrying any commercial load. On the other hand, as will be shown later, the airship exists today which can be transformed into a paying commercial proposition, and in addition the transatlantic flight of the British airship "R 34" has proved that such flights will present no difficulty to an improved model of an airship of this type. By arguing on these lines, we may assume that for long distance flights over the oceans or vast tracts of broken and unpopulated country, the airship will be found to be the more suitable.

Up to the present time, although nearly three years have elapsed since the signing of the armistice, it is disappointing to read that very little progress has been made. In England a commercial airship company seems to be regarded as a new and highly hazardous undertaking. Various proposals have been made by a combine of the several firms which built rigid air ships to the orders of the Government, to certain steam ship companies to exploit the airship. The Air Ministry has been approached and is understood to be willing to lease certain of the service airships for a series of experimental passenger flights.

The Germans, thanks to the genius of the late Count Zeppelin, have been from the beginning the pioneers as far as the rigid airship is concerned. In the year 1910 a company styled the Deutsche Luftfahrt Actien Gesellschaft was formed to run a commercial Zeppelin service and proved singularly successful. Four vessels were utilized, namely, "Schwaben," "Victoria Luise," "Hansa" and "Sachsen." During the period 1910 to 1914 over 17,000 passengers were carried a total distance of over 100,000 miles without incurring a single fatal accident.

At the conclusion of the war a small airship called the "Bodensee" was designed and built with quite remarkable rapidity and not so very long ago a service was inaugurated between the Swiss frontier and Berlin. This airship, in comparison with the war-time Zeppelins, is much smaller, being only some 650,000 cubic feet against the 2 million cubic feet capacity of the latter. In design, too, she differs quite considerably, being much greater in diameter as compared with her length, while all outside surfaces such as fins, cars, etc., are more truly streamlined than was the practice in earlier ships.

Twenty-five passengers can be accommodated in the car and the journey is accomplished in comfort, hot meals being served en route. The scheduled time from Friedrichshafen to Berlin was fixed originally at seven hours, but the journey in favorable weather has been accomplished in half that time. This service was maintained throughout the autumn months when the airship returned to the constructional station in order that an extra section of hull might be added to increase her capacity. It was intended that the "Bodensee" and a sister ship of similar design carry out a service during the summer by means of which Stockholm would be brought within much easier access of the German capital.

It seems reasonable to assume that if such success has attended an airship of small proportions, then infinitely greater results will accrue by building an air ship of size. In the case of the British rigid airship "R-34," when sufficient petrol has been taken to render the transatlantic flight a safe undertaking, the margin of disposable lift available for passengers or merchandise is not enough to make such a trip a commercial proposition.

Fortunately for the airship, in contradiction to the airplane, the percentage of disposable lift increases with the size of the ship and the weight to power ratio decreases. In the airship the capacity, and therefore the gross lift, increases as the cube of the dimensions, so that a comparatively small increase in size is accompanied by an enormous gain in lift, while the resulting increase in the weight of the structure is nothing like proportional.

To give an example, the airship of 10,000,000 cubic feet capacity has five times the lift of the present 2,000,000 cubic feet capacity airship, but the length of the former is only 1.7 times greater and therefore the weight of the structure only five times greater $(1.7)^3$. Moreover the proportion of useful lift, that is, lift available for fuel, crew, passengers and merchandise, is well over 50 per cent when compared with gross lift.

Bearing these facts in mind the following table shows the gain in lift and slight increase in length for airships ranging between 2,000,000 and 10,000,000 cubic feet.

Capacity in cubic feet	Gross Lift in tons	Length in feet	Diameter in feet
2,000,000	66.7	643	79
3,000,000	91.1	736	90.4
4,000,000	121.4	810	99.5
5,000,000	151.8	873	107.2
6,000,000	182.2	927	113.9
7,000,000	212.5	976	119.9
8,000,000	242.8	1,021	125.4
9,000,000	273.2	1,061	130.4
10,000,000	303.6	1,100	135.1

SOME DIRIGIBLE FIGURES OF THE PRESENT AND THE FUTURE

Performance	*2,000,000 Cu Ft Ship*	*10,000,000 Cu Ft Ship*
Gross lift	66.6 tons	303.6 tons
Disposable lift	38.8 tons	200 tons (approx)
Allowance for crew, water ballast etc	11 tons	30 tons
Available lift for fuel and freight	27.8 tons	170 tons
Full speed (10% less than full power)	64.3 kts (74 mph) 1,800 H P	75 kts (86.3 mph) 6,000 H P
Petrol consumption/hr	972 lbs (135 galls)	3,240 lbs (450 galls)
Oil consumption/hr	97 lbs (11 galls)	324 lbs (36 galls)
Cruising speed (fast)	45 kts (51.8 mph) 790 H P	60 kts (69 mph) 3,700 H P
Petrol consumption/hr	427 lbs (59 galls)	2,000 lbs (278 galls)
Oil consumption/hr	43 lbs (5 galls)	200 lbs (22 galls)
Cruising speed (slow)	40 kts (46 mph) 610 H P	45 kts (51.8 mph) 1,800 H P
Petrol consumption/hr	327 lbs (45 galls)	927 lbs (135 galls)
Oil consumption/hr	33 lbs (4 galls)	97 lbs (11 galls)

A series of comparisons have been worked out from the performances of an airship of 2,000,000 cubic feet and those estimated for a vessel of 10,000,000 cubic feet, and are presented in the center panel.

From these figures it will be seen that the endurance and weight-carrying capacity of the rigid airship is merely a question of size. For the 10,000,000 cubic feet airship of the future the range is to almost all intents and purposes unlimited and the weight-carrying capacity large. Some 200 tons lift will be available for fuel passengers and freight and the endurance at cruising speed of 45 m.p.h. works out to approximately three weeks and the range to some 20,000 miles or nearly once round the world.

For the present, however, an airship of this size exists only in the imagination and it will be of greater interest to consider the commercial prospects of an airship already building. Air Commodore E. M. Maitland, C.M.G., D.S.O., R.A.F., the head of the British Airship Service, gave certain facts and figures in a lecture before the Royal Society of Arts in London a few months ago. These are particularly valuable as being the first which can be regarded in any way as official. The type of airship chosen for the occasion was "R-38" (now known as "ZR-2"), which has been purchased by the American Government and is nearing completion at her constructional station. Air Commodore Maitland chose an airship of this capacity since nobody could deny the possibility of building one of this size, although he had worked figures for a 4,000,000 cubic foot ship which gave still better results.

The "R-34" had a total volume of 2¾ million cubic feet. She could carry 15 tons for 50 hours at a continuous air speed of 60 m.p.h. The assumption was made that she would fly about 2500 hours in the year at an average ground speed of 45 m.p.h., although confidence was felt that the higher speed could be maintained. This would yield a yearly ground mileage of 112,000 miles and allowed the airship to be laid up for three months each year.

The cost of such a ship on war figures is £400,000 (about $1,450,000), but it is agreed that with standardization the price should be reduced to £200,000 (about $720,000).

The cost of a base station consisting of sheds, gas plant, workshops and landing rights over surrounding ground is £550,000 (about $1,980,000) or with shed to house one ship, £400,000 (about $1,440,000). A mooring base, equipped with mooring mast, gas plant and small stores, etc., would cost £45,000 (about $162,000). Five houses will allow services to be maintained between all parts of the British Empire.

The route proposed for working out the cost per ton mile is England to India via Cairo. In England and Cairo double sheds would be erected and in India a mooring station. Four airships would be working on this route, each flying 2500 hours, and with this arrangement a weekly service each way would be possible.

Each airship would carry 15 tons load for a journey of 50 hours. The flying time from England figures out as follows: To Egypt, 2 days; India, 4½ days; South Africa, 6 days; Australia, 9½ days.

Various figures have been given for the cost per ton-mile for an airplane service, and these seem to establish the fact that the airship is decidedly cheaper to exploit as a medium of transport. If the cost can be reduced, as Air Commodore Maitland asserts, to a much lower rate per ton-mile by building airships of 4,000,000 cubic feet capacity, passenger fares will be able to compete with steamship rates when the saving of time is taken into consideration.

A second scheme has been worked out in full detail for a proposed service between London and New York.

(Continued on page [illegible])

Synthetic Agriculture

How Knowledge and Consideration of Every Factor Can Increase the Farmer's Return

By Henry Vendelmans, Agricultural Engineer

NO organized industry yields returns that are as widely different as those obtained in agriculture. If these differences could be accounted for by the varying qualities of land, they might seem natural, but they occur as well on land realising similar conditions.

Moreover, the international statistics reveal that the average yield is low all over the world, besides a comparatively few good yields, by far the greater number are small.

These facts are most significant, and as all who are conversant with practical farming very well know, they must be ascribed to the unappropriated conditions of production. As a matter of fact, agriculture, which is a very difficult industry, requiring for its proper working a wider scientific knowledge than any other, is too often carried on in the most indifferent fashion.

Numerous experiments carried out in all countries have proved that practically no soil is rich enough to produce maximum crops, and various means of increasing production have been pointed to. Hence more intensive agriculture with higher yields, but yet here several factors that influence the crops were either not taken into account or were not given attention which they deserve, so that finally synthetic crop production was evolved which brings the possibility of the soil to its very limit.

It represents the most advanced stage of crop production, and is, after all, the only sound one. It is based on the knowledge of the various factors which influence the crops, it has the advantage of being applicable in all countries, whatever the prevailing conditions, because it takes them into account. They are the same everywhere although their value varies practically with every case, so that no easy general rule can be applied, but a previous investigation becomes necessary. This investigation bears not only on the soil, but also on the climate, local conditions, and the possible improvements. To this improved situation the most suitable crops are adapted, the soil being worked by the most suitable machinery and implements. This means a process of selection from beginning to end, which by its cumulative influence not only allows increased yields on good land, but also tends toward bringing the capacity of poor soil close to that of good soil and brings practically all waste land within the scope of reclamation. Although full results could hardly be expected from the first, they are very marked already and go on improving for perhaps three years until the limit of the possibility is reached. The successive improvements may lead to new possibilities in the shape of more valuable crops which become adaptable to the site. When this is accomplished, rotations as they now exist become obsolete and are abandoned in favor of such system of cropping that yields the highest return. One of the consequences is that wheat which has been held to be the staple crop is no longer necessarily considered such and very often will make room for better paying propositions.

In the following survey of the process which cannot possibly cover the whole matter, several interesting points are recorded.

Synthetic agriculture not only investigates into the composition of the soil, but also into its geological origin, which is often more important as giving information about the assimilability of the components but whatever the composition be it is practically never considered rich enough in available feeding elements to supply the food for abundant crops, so sometimes the quantities of manures and chemicals supplemented are extraordinarily high in comparison with what used to be considered a liberal dressing.

For instance, on good land potatoes may receive sometimes, in addition to 8 to 10 tons of farm manure, as much as 10 to 12 cwt. of superphosphates from 7 to 9 cwt. of potash salts, 6 to 7 cwt. of nitrate of soda and so on. Pastures 10 cwt. of basic slag 4 to 6 cwt. of kainit, and 2 or 2½ cwt. of nitrate to the acre every year, according to the quantity of crops taken.

Also more attention is directed toward lime or chalk. In many a soil it gives exceptional results, thanks as much to its flocculating property, and the creation of an appropriate medium for favorable bacteria, as to the supplying of wanted food. The physical conditions of the soil and the subsoil are of far more consequence than they used to be considered. The coarseness or fineness of the particles affect to a great extent the availability of their contents, the power of retaining chemicals, water and fertilising solutions, the development of roots, the aeration of the soil, its permeability, etc., the proportion and quality of the humus. Humus is greatly responsible for the capacity of the soil for retaining moisture probably as many crops are prevented from reaching full development from shortage of needful moisture as from a lack of food.

A good supply of humus yields a more favorable medium for aerobic bacterial life. Excess of humus keeps the soil unduly wet, cold and acid, and may be corrected by applying lime and aerating the soil. Practically 90 per cent of arable land is insufficiently provided with humus. Shortage of humus can be corrected by organic manures green or otherwise. Sometimes no farm manure is produced, but even where it exists the quantity is quite unequal to the requirements of the land. Therefore recourse must be had to green manures as a rule leguminosae are used. They are only exceptionally grown as main crops but are constantly used as catch crops, either on the intercropping or the aftercropping principle. In synthetic agriculture they cannot be dispensed with altogether.

They not only act on the lines indicated above but also enrich the soil in nitrogen, act favorably on the bacteria of nitrification, bring a good deal of water into the soil and darken its color. This latter point, although quite important, seems only to be appreciated by horticulturists.

(Continued on page 88)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Japan and a Big Navy

To the Editor of the SCIENTIFIC AMERICAN:

In the editorial column of your magazine of May 28, 1921, you take up the question of naval disarmament and urge that the United States economise because England has scrapped a large part of her navy. It is agreed that disarmament would be a good thing and we all hope that the day is not far distant when all forms of military equipment will be as far out of date as hoop-skirts, but there are a few important facts that we must not overlook before beating our swords into pruning hooks.

For instance, the naval appropriation of our little neighbor across the Pacific for 1921 is just about a half a billion yen. Now a yen is only equal to fifty cents in American money, but considering the difference in pay of Japanese and American seamen and ship-builders, it equals about two dollars. That brings their half a billion yen up to about a billion dollars against our proposed half a billion. You have correctly stated that naval strength is relative. How long will it be that we will have a relatively strong navy if we do not keep on the increase? So much for that.

Now, the question is what is Japan building such a navy for? She cannot afford such an expensive plaything one-tenth as much as we can. Surely the Chinese or Koreans are not going to jump on them. England and her colonies have no quarrel with Japan. Furthermore, there is a treaty between them. There is nothing that we want that belongs to the Japs. They know that we are not likely to attack them. Therefore, they know that they do not need a navy to defend themselves. There is only one answer left and that is they intend starting a war of their own. And their only possible opponent is the U. S. A. And Alaska and the Philippines are a prize worth going after. And after that the Hawaiian Islands and our own Pacific coast may be [illegible].

History has proven that a small navy is worse than no navy at all. It only sacrifices brave men and good material. A navy at the bottom of the sea should never have been built. Therefore, if we are to have a navy at all we must have one that will overwhelm all possible enemies and do it easily. We must put economy out of our mind and think only of efficiency until that day dawns when we will all send our navies to the scrap heap.

And the one grand argument for world disarmament is to show the world that we are capable of building so much faster and better than they, that they will see the hopelessness of trying to compete and decide that the best plan is to agree to universal disarmament and arbitration of all international disputes. Not one man in a million would think of picking a quarrel with Jack Dempsey. But when Jack gets out of condition and goes back to a second rater, they will all be willing to take a crack at him.

Disagreeable as these facts are we must recognize them and act accordingly. And the only logical thing for us to do is to build such an overwhelmingly large navy that when the world conference for disarmament sits the offending nation will not dare to hold out against the rest of the world. If they are on anywhere near an equal footing there is a chance to quibble and refuse as she has done before. And what is more important still, if she refuses to see the hand writing on the wall and insists in starting a war, we must be so thoroughly able to knock the rays from the sun of the Japanese battle flag that it will never appear on the horizon again.

I am surprised, indeed, that such an admirable paper as the SCIENTIFIC AMERICAN should fail to read the signs of the times. Instead of heckling the Senate into cutting down the Naval appropriation in order that the American people may have a little more money to spend on Fords, prize fights and moving pictures, it should urge the creation of a mighty armada and an overwhelming air force which are the only possible means of bringing about world peace.

History has proved that there is no other course possible. The surest way to provoke a quarrel is to be almost as good as the other fellow, or to even let the other fellow think he is as good as you are. Napoleon thought he could conquer the world and did, almost. Germany thought she could do the same thing and so nearly succeeded that there was no fun in it. Japan has evidently not learned her lesson and until she has, we must build, build, build until she sees the hopelessness and folly of her ways or else so punish her that she, like the kaiser, will no longer be a menace to the human race.

As a peace-living citizen, a Naval reservist, a veteran of the late war, a fairly heavy tax payer and the father of a family which I hope will be able to grow up to manhood and womanhood and end their days without having to face the privation and hardships of another war, I have given deep study to the matter and try as I may, I can see no other solution to the world's most important question. F. P. ARCHER.

Wilkes Barre, Pa.

P. S.—Upon second thought, I believe you printed that editorial just to start something. You have. Go ahead and publish the answers if there are not too many of them.

[If our correspondent is right in his estimate of Japanese policies his point is well made. We think he is wrong.—EDITOR.]

Why It Has Been So Hot

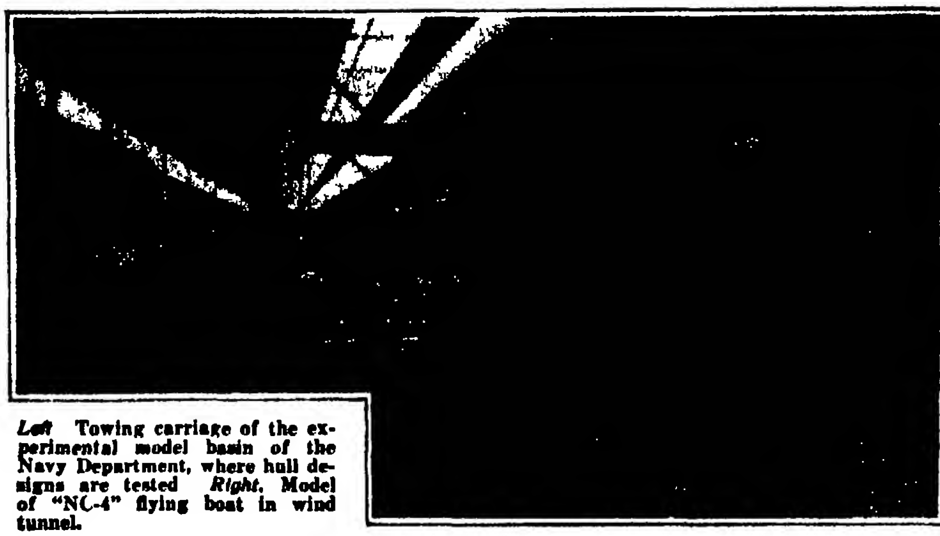
To the Editor of the SCIENTIFIC AMERICAN:

I enclose a weather prediction and statement of the cause of the extreme heat of the last few days, from the pen of our local weather prophet who furnishes forecasts for one of our dailies. This organ is supposed to be under fairly intelligent management, but evidently prints this yarn with complete faith in its authenticity. Its author views the solar system from the top of the ten story newspaper building (in which he operates the elevator), and arrives at the remarkable conclusions set forth in the printed item. I read it with a mixture of interest and amusement which I hope may be shared by your readers. Here is what he says:

"It is likely that the whole solar system is passing through a zone of heat, as it sometimes does. Such heated zones are created by a nearer approach to some stars or sometimes by the combustion of a comet. There was an instance of the earth passing through such a zone in 1838, where the disintegration of a comet was believed to be the cause."

Let us trust that the solar system will soon get through the heated zone that it has encountered in space, and perhaps it is given to hope that it will not next run into a damp region of the universe that will result in excessive precipitation! J. S. C.

Battle Creek.



Left Towing carriage of the experimental model basin of the Navy Department, where hull designs are tested *Right.* Model of "NC-4" flying boat in wind tunnel.

With Model Basin and Wind-Tunnel

How Our Naval Constructors Check Up Their Designs by Means of Miniature Hulls and Model Airplanes

OUTSIDE of technical and shipbuilding circles there is not much known of an interesting establishment in Washington which has contributed in no small degree to the development of the American Navy during the last twenty years and to its success in the Great War It is known as the Experimental Model Basin, and consists of a large laboratory where researches are made to determine, by making small wood models and towing them in a miniature ocean, the best form or shape for the under water part of all naval vessels It is possible in this manner to know long before a ship is built just how much power must be generated by the boilers and the engines to drive the ship at sea at its designed speed

When it is considered that each of the great battlecruisers, 850 feet in length, now building for the American Navy, will require 180,000 horsepower to make a speed of 33 knots or practically 38 land miles per hour, and that each will cost when completed and ready for battle about $30,000,000 the importance of the work done at this laboratory will be better understood When a ship is said to require 180,000 horsepower it means that the strength and force of the machinery applied through the propellers to the water is as great as if it were drawn through the water at the top speed by 180,000 horses. If the resistance of the ship can be reduced by even one per cent, it means that the work which would require 1800 horses to do, can be saved

In 1896, when the large expansion of the Navy began, the Navy Department obtained authority from Congress to build the Model Basin and to equip it for its important work in the construction of new ships Before that time and until it was completed and put in operation in 1900, it was necessary for the Naval constructors to depend in the design of new ships, on experience with previous ships and on what they could learn from European testing basins, particularly from England where the method was first developed by Dr William Froude Without such a basin the American constructors were at a great disadvantage. Before this scientific method of ship design was introduced, from the days of the "Constitution" and other famous frigates down to the iron-clad vessels of the Civil War, they had shown themselves capable of designing as fast and powerful war ships as could be built by any other nation So in building up a new and greater navy, a model basin was a necessity if America was not to lag behind its possible competitors in sea warfare

To illustrate the saving in power made possible by the new methods, a comparison of the battleships 'Connecticut' and "Michigan" may be given The first was designed by the old methods and the second by the model basin method These two vessels are of exactly the same length and displacement, but to make their designed speed of 18 knots the "Connecticut" requires 15,475 horsepower and the "Michigan" is obliged to use only 12,850 Moreover, the saving in the necessary weight of machinery was available for considerable increase in the weight of guns and armor, making the "Michigan" a more powerful fighting ship

One of the accompanying illustrations shows the interior of the testing basin, which is 435 feet long, 42 feet wide, and 14 feet deep, all enclosed in a building to permit experiments being made in all kinds of weather On either side of the basin are heavy steel rails on which runs a traveling crane, or towering carriage, driven by electric motors in a manner quite similar to a street car

The models, twenty feet in length, are made of wood by expert model makers, as exact copies of the underwater part of the ship to be built Another view on this page shows the model of a fast cruiser being finished by a model maker and inspected by the Naval constructor in charge of the Model Basin When finished, the model is placed in the water, ballast added until its draft corresponds to that of the ship, and then put under the towing carriage to which it is attached by a spring scale which weighs the force required to pull it in the water at different speeds

Fortunately, it is not necessary to pull the model at the same speed as the ship but at a much lower speed Thus for a ship 500 feet in length to run at 20 knots it is necessary to tow a twenty foot model only one-fifth as fast, or at 4 knots. Where the model has been tested at a number of different speeds, say from 1 to 4 knots, the corresponding resistance of the ship at speeds from 5 to 20 knots is readily found by taking into consideration the difference in weight or displacement between the two

After the model resistance is measured, the propellers are put on the tiny shafts which are revolved by small electric motors so as to drive the model through the water By measuring the horsepower taken by the motors and the speed of the model in the water and comparing this power with the resistance of the model as previously found, it is possible to know whether the propellers are of the proper size and form to be efficient when used on the full-sized ship. If the propellers do not work well, others are made and tested until good results are obtained By these tests it is possible to know exactly how much power is needed for the ship and at what revolutions per minute the propeller will run

The facilities of the testing basin are used to a large extent by private shipbuilding companies to test the models of merchant ships. For such test they are required to pay the actual cost to the Government—about $500 for each model tested

The same principles used in testing ship models are also used for testing models of airplanes and dirigibles. To assist in the development of Naval aircraft the Navy Department in 1918 added a large wind tunnel to the laboratory equipment. The tunnel, which is the largest in the world, consists of a large air pipe, having a section eight feet by eight feet, through which the air is blown by a 500-horsepower motor-driven fan. A wind speed as high as 150 miles per hour may be obtained In another view is shown the model of the seaplane "NC-4" in position inside the tunnel, ready for the test. The models are made 36 inches wide, that is to say, from one-eighth to one-fortieth as large as the full sized airplane, depending on the magnitude of the finished machine

By setting the model at different angles to the wind and weighing the lifting force and resistance of the model, it is possible for the constructors to compute in advance how much weight the airplane will carry and how much power will be required to drive it. Also, what is even more important for a flying machine, they can tell whether it will balance properly in the air and stay right side up. In the early development of airplanes many valuable lives were sacrificed because of lack of this quality, and quite aside from the ordinary engineering considerations of economy and efficient operation, this saving of skilled man power is something well worth the cost of the wind tunnel, alike on engineering and on humanitarian grounds.

In the design and construction of the Navy seaplane "NC-4" the first aircraft to cross the Atlantic Ocean, careful model tests were made of models both in the wind tunnel and in the model basin to insure that the craft when built would do what was expected of it. The success of this design is ample evidence of the value of model tests of seaplanes. Incidentally, the seaplane, with the opportunity it gives to use wind tunnel and model basin in conjunction, presents a new combination in the experience of the engineer.

Applying the finishing touches to a model hull of a future battleship, under the supervision of naval constructor

Steaming the Tobacco Field

"BURNING plant-bed land" is a familiar phrase in the tobacco-growing areas of the South, where open fires are built on the plot of ground to destroy weeds and other extraneous growth before tobacco seeds are sown to produce seedlings for transplanting. The tobacco-producing district of the Connecticut Valley is replacing this method by a steaming process—an inverted pan is employed in driving steam into the soil.

The equipment used in sterilizing tobacco seed beds, thereby eliminating the practice of an intensive burning of brush and wood on the land, consists of: A portable boiler of 20-horsepower, heavy ¾-inch steam hose, 25 feet long, ¾ inch iron pipe long enough to convey the steam from the boiler to all portions of the seed beds; heavy canvas or burlap, 216 feet square; a steaming pan to cover an area of about 72 square feet.

The boiler is placed close to the bed, and the inverted pan is set on one end of a bed with its inlet nearest the boiler. Soil banked around the edges of the pan traps the steam. Pressure in the boiler is maintained at 100 pounds, 70 pounds of steam being the minimum for effective sterilization. Thirty minutes' steaming is sufficient for a given area, the pan being moved along to a fresh spot. The soil is so improved that less fertilizer is required to produce thrifty seedlings. The apparatus designed for tobacco beds, with slight modifications, can be applied in soil steaming in greenhouses, outside frames, and even in open fields. Plant diseases are thereby eliminated as well as weed growth stifled by killing the seeds of extraneous growth, and the way is thus laid open for a bumper crop in the absence of such competition.

Boiler and auxiliary apparatus for sterilizing tobacco seed beds, connected for practical performance

Platform corn harvester in operation. Two men with this machine drawn by one horse can cut and shock as much corn in one day as three men cutting by hand

When Oil Stops the Shifting Sands

BETWEEN Pendleton in Eastern Oregon and the mouth of the Columbia River the building and maintaining of the Columbia Highway has met aggravating conditions caused by the careless conduct of the wind that blows upstream almost constantly through the summer months. The high waters of the Columbia River in the spring carry down huge deposits of sand and silt. When the waters have gone down the sand remains, dries out and the wind carrying it away forms dunes similar to those found along the ocean beach or on the shores of Lake Michigan.

These constantly shifting sand dunes had to be tamed in some manner so after unsuccessful efforts to regulate things and to keep the dunes from encroaching upon the newly constructed stretches of highway it was decided to use oil. The oil was applied to the slopes as well as to the shifting sands as far as possible on either side of the road.

The equipment for oiling the sands consists of two supply tanks or drums and a tractor which draws the oiling rig and supplies steam to the compressor tanks carried on a trailer. The oil is heated by the steam and is forced through a hose with a nozzle made of a short piece of half inch pipe. The oil is atomized by the steam and is sent in a fine spray for 100 feet or more. The distance the spray carries depends a great deal upon whether it is directed with or against prevailing winds. Where possible the spraying is carried on with the wind.

It is claimed by highway engineers in charge of this construction work that where sufficient oil is used this method is very effective and the cost will, no doubt, not be excessive.

The Platform Corn Harvester

CORN is one of America's big crops, and its magnitude alone would suggest the difficulty of the task in harvesting the immense acreage. Moreover, corn-harvesting is limited to a few days if the feeding value of the fodder is to be completely realized. Speed is essential to cutting the corn for silage or fodder. Hence, the value of a platform harvester which can be purchased or made at home. The photograph herewith describes the two-row harvester. Two men with a platform harvester and one horse can cut and shock as much corn in a day as three men cutting by hand.

This machine is a sled platform or a platform mounted on small wheels, with knives attached for cutting the stalks. Home made platform harvesters can either be mounted on sled runners or on wheels. The harvester is pulled by one horse and cuts two rows at a time. Two men ride on the platform to catch and support the stalks as they are knifed. When cutting corn for fodder, the horse is halted when the shock is reached, the operators carry the cut corn to the shock, return to the cutter and proceed toward the next shock.

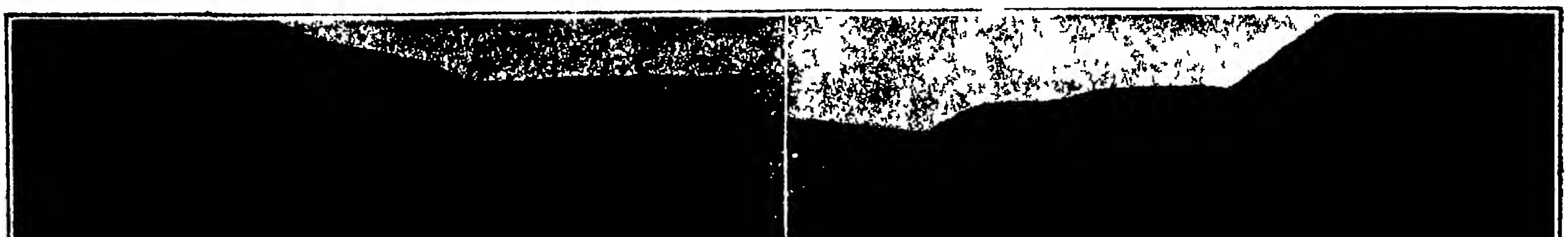
The original cost of a platform harvester ranges from $20 to $50 depending on the make-up of the machine. Devoid of many movable parts, the repair bills are almost negligible. Sharpening the knives usually represents the expense of upkeep. It is estimated that the machine can be operated at a cost of twenty-five cents an acre. Cutting corn with a corn binder is much more expensive, to take no account of the expensive investment of acquiring a cornbinder.

Non-Metallic Gear Material

UP to a few years ago practically all noiseless gears were made from rawhide or hard fiber. Both of these materials are unsuitable for timing gears, because they swell and distort when immersed in oil. Recently a number of non-metallic materials have been developed which have sufficiently high mechanical properties to permit of their use in toothed gearing and are non-sonorous and impervious to oil and alkalis. One of the latest of these materials contains two basic elements: a phenol formaldehyde condensation product and a fabric.

The material is as strong as cast iron, is not affected by moisture or oil, is of a high dielectric strength and is inert, insoluble, and resistant to most acids.

The apparatus used in putting down the oil to make a road on sand



Condition of the Columbia River highway through the sand-dune district before (left) and after (right) the application of oil to the sand formation. The left-hand picture is actually of a finished and graded section of the highway, little as it appears so

Transporting Electric Current

Modern Transmission Lines and the Manner of Their Construction

By J. F. Springer

Economy is the object of this surprising method of assembling the towers on the ground and tilting them up into the vertical position

ONE of the great advantages of electricity as a source of power is the ease and certainty with which the power may be transmitted from point to point. This is one of the basic reasons for the gigantic developments of water power sites in recent years. Such sites are often in locations far from any of the points where power is to be used. The nearest point of consumption may be 100, 200 or even more miles away. The natural obstacles that intervene may be frequent and formidable. Where long distances are involved the voltage is naturally set at an excessively high level so that the problem of transmission becomes complicated with safety questions involving property and life. The total cross section of conductor may be very considerable because of the amount of current that is to be transmitted. This will be accentuated where some other metal than copper (as aluminum) is employed. In addition to the strictly engineering matters the transmission engineer must consider cost. The entire development including the transmission line must make a reasonable profit. The reader may perhaps gather from the foregoing outline that the transmission problem may often become one of considerable difficulty.

In the older days when the distances were short and the voltage low the wooden pole was found sufficient. And today where it is merely a question of supporting telegraph, telephone, electric light and trolley lines the pole is in general use. It is usually of wood but is sometimes of concrete or steel. But the steel tower is now rapidly coming into use, especially where heavy currents of high voltage are to be transmitted.

The wireless tower is a related affair. Its function is to support the aerial. While there are relatively few to erect, each unit may easily be a very considerable structure. In fact the tallest steel towers erected in recent years are probably nearly all to be classed as wireless towers.

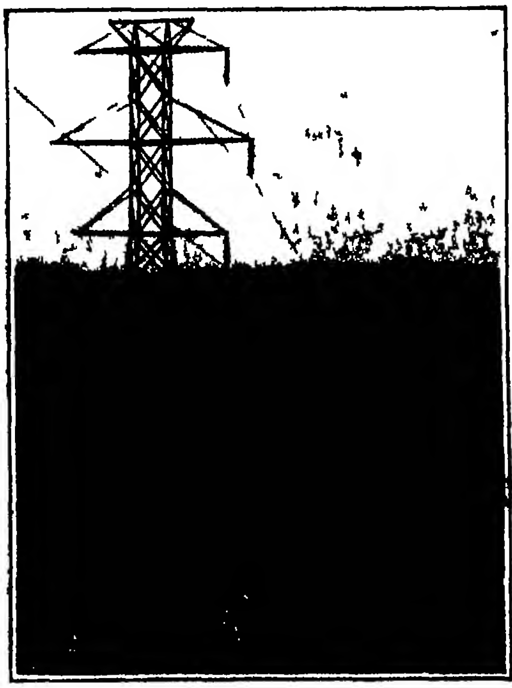
The wooden pole is in great use in connection with the transmission of electric current especially where the weights to be carried are not excessive and where nearness to the ground of the conducting wires or cables is permissible. The erection of long unwieldy and heavy poles is no trifling problem especially if it be required that the expense per pole be kept at a low level. One method makes use of a derrick mounted on four wheels. If the poles are to be alongside a railway or trolley track the movable derrick may have a track car for its supporting element. Mr. W. A. Ladue, a superintendent of a New Jersey public service company, built some years ago a special derrick wagon which is able to erect poles at points 10 feet from the wagon. The derrick mast is supported at a point between the ends by an axle and a universal joint. It is temporarily guyed back by ropes attached to a ring at the top and to convenient points of attachment near by. The use of this apparatus may be taken as fairly representative of up-to-date practice with poles.

The wooden pole is, however, becoming obsolete where heavy power currents have to be transmitted considerable distances. To get the wires up to new levels and to carry heavier weights are requirements that have been met by the use of steel structures. Sometimes the towers are very considerable affairs, so that their actual erection at an economical expenditure requires careful attention. An analogous structure is the tower for a modern wind mill. These are erected in more than one way. Sometimes the complete tower is built in a horizontal position on the ground, and then the whole affair is set up on its base. At other times the structure rises piecemeal from the ground up.

If the tower has quite a narrow base, it may be classed as a pole and be erected similarly. Likewise, the structure to be set up on end may be two adjacent uprights of a tower and the connecting framework. This may be set up after the manner of a tower with a narrow base. The procedure may pursue the following lines. The *gin pole* is relied on as the erecting appliance. In the present case this may consist of a long and fairly heavy pole pierced transversely at intervals. A pair of wheels on an axle may be used to help in the transportation of the pole and in the earlier part of the operation of upending it. The axle may be passed through one of the perforations in the pole, the selection being made according to the conditions at the moment. A couple of ropes are secured to the smaller end of the gin pole. At the bigger end a triangular frame is secured to the pole in such way as to be in the same plane with the axle. The base of this triangle may be nothing more than a strip of wood so arranged at the end of the gin pole as to be perpendicularly bisected by it. The sides of the triangle may extend from the ends of this base to points on opposite sides of the pole. The result of this arrangement is to provide the gin pole with a broad base. When this base is put into contact with the ground—as by lifting the opposite end of the gin pole—and held against slipping, by stakes or otherwise, the gin pole may be made to rotate upward, on its triangular base as a hinge, by pulling on the ropes. This pulling may be done by hoisting engines or by man power. After the pole has been pulled up somewhat, its smaller end may be secured to a suitable point on the framework of the narrow tower. The foot of the tower is prevented from slipping by wooden stakes driven into the ground or by some equivalent means. If now the ropes to the gin pole be pulled on again, the pole and the tower may both be rotated, as hinges, until the tower has come to the vertical. Some reader may wonder why the gin pole is used at all and why the tower is not erected at once just as the gin pole is erected, by pulling on the ropes attached to it. In answer to these questions, one may say that it is desirable to have a considerable angle, in a vertical plane, between the tower or pole and the rope attached. By first tilting the pole a sufficient angle is made possible for the moderate weight of the pole alone. Later, when a rope is arranged to connect gin pole and tower, there will be a considerable angle between this rope and the length of the tower.

It is quite customary to assemble and bolt or rivet together the complete tower in a horizontal position. The advantage of doing all of this work close to the ground must be well nigh obvious. However it increases the difficulty of erection. Nevertheless this method is probably more prevalent in the United States than the alternative of piecemeal erection in absolutely

(*Continued on page 88*)



Another representative design for a modern all-steel tower

Erecting a flexible A-frame carrier for a double-circuit [illegible]-volt line

With the Engineers of Industry

A Department Devoted to the Physical Problems of the Plant Executive

This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work. The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.

The Value of Clean Windows

IT is all well and good to preach the gospel of the clean and airy window, but generally this practice is considered to be in the interests of some manufacturers of special windows or window cleaning companies. So it is refreshing to have the same point of view brought out by an absolutely disinterested party—disinterested from the commercial standpoint, but very much interested in the health of the workers.

Writing in a recent issue of *The Times Trade Supplement* of London, an English doctor has some interesting things to say about sunlight and fresh air. The dirty window, states this authority, is a kind of screen between health and those who seek it. Like the coal smoke, it impoverishes the sunlight. Unlike coal smoke, it can be removed at a relatively small expenditure of trouble. Sunlight exercises a profound effect in killing the germs of disease. More important than this is its effect on the human being at work. This effect is becoming better understood as time goes on. Recently, Dr Leonard, the well-known English authority, wrote:

"The citizen, by his indoor life and by the smoke and dust of cities, is withdrawn not only from the influence of sunlight, the radiant energy of which has undoubtedly a most potent influence on the cutaneous (skin) nerves and feelings determined by these, and probably a no less important influence on the blood and other tissues exposed to its action."

The dirty window, of course, shuts out what little of the sunlight this individual might obtain. As Dr Hill points out, the winter life of a city dweller is a poor substitute at best for "a man's life." He spends his day within doors except for a brief walk to work or the train. The quickening effects of the sunlight are denied him even when the sunlight is available, for the dingy office or shop is provided against the penetration of that healing warmth.

This is all loss, continues our English authority. Men so weakened by their surroundings cannot and do not remain in good spirits. They become pale and irritable. They work badly and they develop distempers of the mind. Like sickly plants, they become the easy prey of disease. Their output is below that of which they are capable.

The lesson to be derived from the foregoing is that it is the part of good business administration to provide ample window space in the shop, office or factory building in the first place, and to keep such windows or any other windows clean at all times. Tests made on employees working behind dirty windows and the same employees working behind clean windows generally reveal a 5 to 15 per cent increase in efficiency. There is no question about the importance of ample light, particularly sunlight where possible, in the workaday world.

Organization Motion Pictures

IT is a well-known fact that motion pictures are being used for advertising purposes, some of the advertising films actually being shown in the smaller picture theaters, along with the usual productions. But the possibilities of employing motion picture films for organization work in the large and small plants alike have not as yet come to be appreciated by the business world in general.

There is no better way of telling a story or explaining certain machinery or work than by motion picture. It speaks the only universal language extant, to begin with; and whether the plant has Poles, Hungarians, Russians, West Indians and other miscellaneous races, or just plain Americans, the motion picture can be understood by all. Then the motion picture has an exceptional [illegible] when it comes to explaining an idea. It [illegible] the various steps in the explanation to be taken up one by one, with close-ups and animated cartoons and even animated models to emphasize points. The same motion picture film can be viewed by thousands of workers as often as may be necessary, as compared with the usual lecture method. Again, the motion picture commands undivided interest. If 5000 men are viewing a motion picture presentation it is a pretty safe guess that not more than a handful are not concentrating their attention on the screen. In that respect no bulletin, poster, individual letter or talk can compare with the motion picture, which positively leaves a permanent impression.

Organization films are intended to bring out certain ideas that will make for better work and better working conditions in any organization. For instance, some companies have had films made to show the various activities of the company, in order to instill a better understanding of the organization, its ideals and achievements, and also in order that the individual worker might have some idea as to where he or she fits into the general scheme of things. Films have been made showing the right and the wrong way of doing a given task. What better argument could be found than to show a worker a motion picture film which depicts the wrong way of turning out his work along with the value of the merchandise which such labor has produced, and then to show the correct way along with the increased value of merchandise thus produced. The fact can be brought out that the more the worker produces, the more his earnings.

Fortunately, there are numerous firms specializing in non-theatrical work today. The cost of making special films is not prohibitive, particularly in view of the service which such films give. Non-theatrical projectors are now available in a wide variety of designs for the projection of the standard sized celluloid film or the so-called Safety Standard film which is made of acetate of cellulose and is therefore slow burning, being approved for use anywhere and by anyone without special fireproof booth or license.

The Diesel Engine Ashore

THE mention of Diesel engines generally calls to mind a ship installation or even a submarine riding on the surface of the waves. Yet as a matter of fact it appears that the Diesel engine is making good progress ashore, and is to be found in many large plants. Thus one of the recent installations of the Diesel engine comprises four engines, each a 2000-horsepower, four-cylinder two-cycle unit, built for the Phelps-Dodge Corporation, one of the largest mining companies in the world. These four Diesel engines are the largest of their type ever constructed for stationary use in this country, and in horsepower per cylinder they are said to exceed any Diesel engine ever built in the United States. Two of these engines are going to old Mexico and two to Arizona. They will be direct-connected to 1850-kilowatt alternating current generators to supply electric power for copper mines. Some conception of the enormous size of these units may be gained from the following facts. The height from engine room floor to top of engine is 23 feet, the total length, including generator, is 51¾ feet, the width, 19¼ feet, and the net weight, 650,000 pounds.

The Diesel type of oil engine is being rapidly adopted for municipal and general power plant use and especially for driving auxiliaries because it produces power at a lower cost than any other type of engine. Since the type we are referring to is of the two-cylinder design, it requires less floor space than those of the four-cylinder design, and having less weight, it reduces installation cost and fixed charges. It will operate successfully on a large variety of low grade fuel oils, the special atomizing nozzle taking care of oils from 28 to 12 deg Baumé.

Another typical Diesel engine installation is a 1250-horsepower unit direct-connected to a two-stage compressor, which is installed in the power plant of the Detroit Copper Company at Morenci, Arizona. The compressor has a capacity of 6400 cubic feet when running at a maximum speed of 180 r.p.m. The output of the compressor is varied by changing the speed of the Diesel engine. This is accomplished automatically by an air governor which varies the speed of the engine between 90 and 180 r.p.m. to meet the demand for air.

Diesel engines are made for either constant or variable speed operation. Such machines as compressors, blowing engines, pumps, ice machines and so on are commonly driven by the variable speed type, while many notable installations of the constant speed type have been made in electric light and power plants, flour mills, textile works, ship yards, cement plants and mines.

Putting Waste Vapor to Work

THE manner in which the capacity of a heating plant for a paper mill was increased by the proper utilization of waste vapor, is described by W. H. Howell, Jr. in a paper read before the Technical Association of the Pulp and Paper Industry. This novel scheme is quite typical of what is being done in many progressive plants with a view to reducing their overhead as far as possible during these days of slack trade.

As Mr Howell stated, the usual practice has been to heat fresh air from outdoors by carrying it over steam coils, blowing it into the room and taking out the moisture from the driers, either by having openings in the roof or with exhaust fans. This system has been quite highly developed and gives satisfaction provided it is properly installed.

At the mill referred to, this old system was in use, but as the production was increased about 100 per cent it was found to be inadequate. It was then arranged to ventilate the machine room with two fans. One exhaust fan is used for pulling moist air out of the machine hood to the economizer and a supply fan distributes the warm air to various points in the room. The hot outgoing air and the fresh cold air crisscross each other in the economizer without actual contact except through corrugated plates. The object of the corrugated plates is to enable the closest possible contact for transmission of heat from hot moist air to the cold fresh air, at the same time separating the moist air from the dry air. Both fans are belt-connected to a single 20-horsepower constant speed electric motor.

In average winter weather (34° Fahr.) the economizer is able to raise the outdoor air to 107° Fahr. for distribution in the machine room in quantity sufficient for all ventilating purposes and without the use of any steam whatsoever. This result is accomplished solely by utilizing the waste vapor going out of the machine hood and still leaving a large quantity of vapor available for other heating purposes.

It was found that 107° was too warm for the comfort of the operators, and a certain amount of moist air was consequently allowed to escape into the atmosphere without passing through the economizer, so as to bring the air temperature supplied to the room down to 98° or 100°.

Mr Howell stated that, so far as he knows, this is the first practical use of the idea on a large scale for heating and ventilating a machine room without the use of steam from the boiler plant. By its means first-class ventilation conditions are assured in a place that formerly presented a very difficult and expensive operating condition. Of course the intention is also to use such waste heat in some cases to assist drying operations in summer.

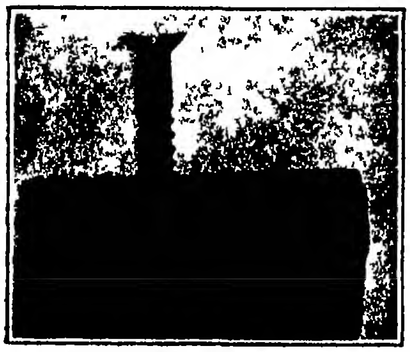
Wheel or "Snow-Burned" Rails

THERE is a prolific source of injury to rails which has attracted little attention considering its general prevalence: that is, wheel-burnt rails, so-called, says a report of the Committee on Safety of Railroad Operation to the National Association of Railway and Utilities Commissioners. The slipping of wheels causes abrasion of the metal at the running surface of the rail head, attended commonly with the generation of intense heat by the frictional resistance involved. The term "snow-burnt" is employed in some localities, having the same meaning as wheel-burnt, due to the fact that slipping of the wheels occurs during attacks on snow-drifts.

The heat generated on these occasions exerts a pronounced effect on the metal along the top of the rail. A thin layer of metal raised to a scintillating temperature, rapidly cooled by conductivity, renders the steel excessively hard. Less rapid cooling anneals the steel. Deep abrasion of the surface affords opportunity for the inception of a line of rupture. The large number of wheel-burnt rails and the small number of accidents which result from them indicate that ordinary injuries are not serious, but none can be regarded with indifference. This branch of the rail question is far more complicated than is realized.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



Sectional view of brick wall in which a special plug has been inserted to take a wood screw

Screw Holes for Screwless Places

A NEW device which permits an ordinary screw or wire nail to be fastened permanently in tile, brick, metal, concrete marble, slate, glass plaster or any other substance, has been perfected and is being used Builders, plumbers, electricians, and other tradesmen as well as engineers and laymen will appreciate the advantages of such a practical and useful article, which can be quickly and easily installed for the hundreds of uses to which it is suited

The new device consists of a hollow tube of longitudinal strands of jute fiber cemented in such a manner that when in position it is unaffected by moisture or temperature changes It is applied by drilling a hole of the proper size in the material to receive the plug with a sliding fit The plug is then inserted, and as the screw or nail enters the plug, the fiber strands expand filling the pores and becoming an integral part of the substance in which it is inserted

Tests made under actual working conditions have shown that this device with stands a direct pull of 100 pounds in plaster, 600 pounds in iron, and 1250 pounds in common brick, when a No 14, 2 inch screw was used A greater resistance was shown when an indirect pull was used

Providing the Rake With a Cutter

FINDING it impossible by hand labor to keep Bermuda grass out of the two-acre lawn of the palatial home where he was employed as head gardener, Albert Conrad of Pasadena, Cal decided to do some experimenting He fastened a long, sharp, broken knife-blade across a common wire rake, and hacked the running grasses and weeds with this It encouraged his idea and he set to work to chisel by hand out of cold steel what has come to be known as a cutter bar rake Each tooth knife-like and pointed and set at a peculiar angle, is detachable so that it may be ground anew when dulled, and these teeth fastened against a sharpened bar make an effective weapon with which to fight the wild grasses A lawn is cut and combed by it the fine grass passing through between the square-set teeth, while the runners and coarse roots are separated and drawn out by the quick jerk upon the handle

For eighteen months this gardener used his new implement. Finding that a few helpers could do the work formerly done by fourteen and seeing the rejuvenation of the old lawns, made new by the combing and re-seeding that was now an easy matter, he finally secured patent rights and put the handy, sorely needed tool upon the market. Thirty six hundred are now in use in southern California Park commissioners are finding them of special value in caring for large lawn areas.

Rake fitted with cutter bar to facilitate the work of gardening

Mr Conrad has also attached a little hoe to one end of a light weight rake, (at right of photograph) which gives a worker a double implement This lighter rake is used upon lawns in good condition, while heavier ones are necessary where old grounds are to be made new

Taking the "Kick" Out of the Shotgun

THE 'kick less shotgun is a frequent object of ingenious inventors. While the recoil or 'kick' of many different kinds of guns has been put to work by making it eject the spent cartridge shell and reload the gun, thus resulting in an automatic gun, for the most part such efforts have taken the form of ingenious though simple shock absorbing stocks. One of the latest of such devices is shown in the accompanying illustration The stock of this shotgun, it will be noted upon careful study, is divided into three parts, between which are placed suitable compressible springs. The springs can be adjusted for any desired degree of resistance or shock absorbing qualities by the knurled wheels. It is claimed that this form of stock absorbs 70 per cent of the force of recoil

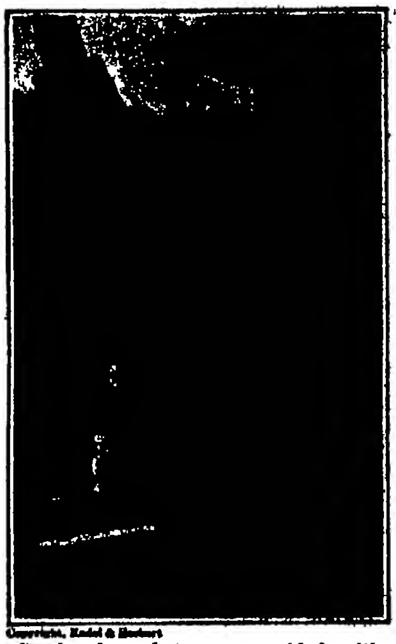
Hot Water for the Country Home

THE problem of hot water in the country home is always a serious one Of late years there have been several ingenious hot water systems introduced, among them the automatic gas water-heater which automatically heats the water when a faucet is turned on in any part of the house Where gas is not available however it would seem that some ingenious inventor could develop an oil water-heater that would also be automatic

A Tennis Ball That Can Be Pumped Up

A NEW tennis ball manufactured by a New York concern may be pumped up like an automobile tire when it feels rather flat after a strenuous game The inner ball of this tennis ball has a small knot of soft rubber attached to it and through this knot of rubber the ball is inflated before the outside felt cover is adjusted When it is necessary to reinflate the ball the needle of the inflating device is pressed through an indelible cross marked on the cover By pumping, the air is forced into the ball till it feels sufficiently hard for use By pinching the ball with a pair of small pliers at the place the puncture is made, the sealing is made doubly safe as the knot of soft rubber closes up after the needle point has been removed

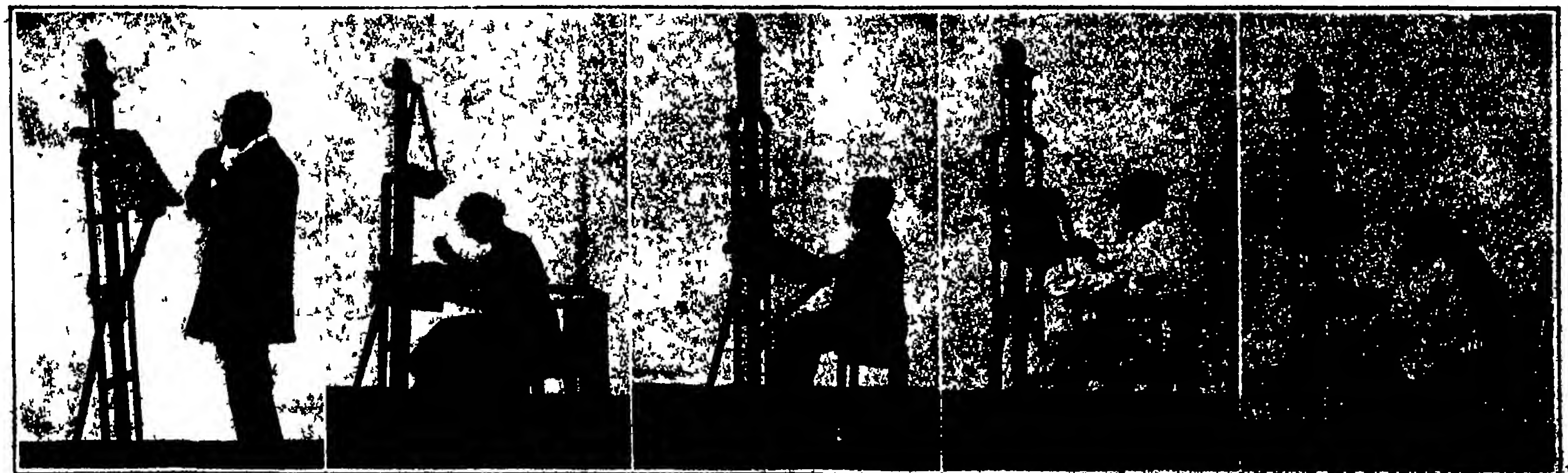
Pumping up a soft tennis ball of new design, to make it like new



Stock of a shot-gun, provided with adjustable springs to take up the recoil or "kick"

An All-Round Piece of Furniture

FROM Germany comes the all round piece of furniture shown in the collection of photographs at the bottom of this page This piece of furniture is a highly ingenious combination of easel and table, and may be used for a variety of uses. First of all, it may be used as a music stand, as shown in our first illustration The housewife may find it handy as a rest for her needlework, while the student may use it as a book rest and writing desk The artist could hardly find a better easel than this simple piece of furniture The fair sex, by means of a large mirror and the table attachment, can convert the same piece of furniture into a dressing table



Some of the many uses to which an ingenious piece of German furniture may be put in the home and in the artist's studio

What Are Vitamines?

(Continued from page 76)

Recently the discovery has been made that the food richest in vitamines is yeast, of the sort we have always thought useful chiefly for making bread and beer. As early as 1852 an English physician named Moss reported the successful use of yeast as a medicine, but nothing came of it. There appeared no good reason why a man should take yeast, for instance, when affected with stomach trouble.

But in 1917 Dr Philip B Hawk of Jefferson Medical College, published the results of an intensive research which he had conducted with yeast and gave new impetus to the interest of the medical profession. Since then a number of eminent physicians have collaborated in this work and at least two of the largest hospitals have loaned their facilities to the investigators.

It now appears that there was a very good reason for the English doctor's "foolish" notion although he himself did not suspect it. Yeast contains in highly concentrated form the Vitamine B and is particularly useful as a general conditioner. Says Dr Hawk in one report:

"In many of the cases which came under our observation the yeast treatment caused an improvement in the general physical condition of the patient quite unassociated with improvement of the symptoms of the particular disease in question.

Diseases which appear to improve from the yeast treatment include stomach troubles of all kinds, constipation run down and nervous conditions, loss of weight and appetite, boils, blackheads, and others. The improvement appears to come from the stimulative effect of the vitamines on the glands, especially those of the digestive system, combined possibly with some other unexplained properties of yeast.

Another significant conclusion was drawn from the feeding of yeast to rats:

'A scrawny lethargic animal, rather dwindling in size with unsleek coat and evident malnutrition will completely change its appearance and responses in a few days at most on a diet unchanged except for a tiny bit of yeast.'

Undoubtedly many persons are suffering from a lack of sufficient vitamines. We use only the starchy part of our wheat, polish our rice, peel our vegetables and fruits and thus remove from our diet most of the vitamines. General health could without doubt be improved by replacing these lost elements. In this connection an eminent physician recently suggested that we eat at least a quarter of the skin of each orange because it is rich in vitamines.

Dr R Adams Dutcher of the Division of Agricultural Biochemistry of the Minnesota Agricultural Experiment Station has experimented in the feeding of vitamines to farm animals:

'From the standpoint of the stock feeder as well as from the sociological standpoint," he says, "this work suggests two important things which merit emphasis: first, the question of diet in relation to sexual vitality, sterility, etc., and secondly, the importance of fresh green foods for all growing animals, especially poultry. We have cured limberneck in fowls by administering a vitamine extract prepared from wheat germ.

"It is very possible that the laxative action of many fruits, whole grains and bran is due in a measure to increased gland secretion brought about by the vitamine stimulation. As a result of our observations we wish to state tentatively that the actions of the organs of internal secretion are dependent upon the stimulating action of the vitamines. Whether this is in the nature of a nerve stimulant, nuclear nutrient, or chemical nucleus of a hormone is of course a matter of speculation."

But we are interested here, not so much in the improvement of the general health during normal lifetime as in whether this line of experimentation offers any hope that human life can be extended beyond the one-hundred year mark which, so far has been nearly always the absolute limit of life. Will it not be possible when the vitamines themselves, their effect on the glands, and the effect of the glands on the body are better known to live for two hundred or five hundred years?

We may reasonably conclude from the scientific evidence already at hand that such a thing is plausible at least. There seems to be no doubt that the potential immortality of the cells which compose the body has been established. There is a growing volume of evidence, perhaps not conclusive but making the probability very great, that old age is induced principally by the failure of certain glands which exert a mysterious but a very real influence upon all of the bodily tissues. Finally, the life and vigor of these glands seems dependent upon the mysterious food element, vitamines.

It is too soon to draw positive conclusions, but certainly the path to a vast new field of research is now cleared away which field may hold tremendous results for the human race.

Home Building Simplified

(Continued from page 79)

to their six and eight room dwellings when economic conditions are again settled? I do not think so. I know of one case in the middle-west where a new apartment house has been built beside an old style one. The new apartments have three rooms as against six in the older one. The quality of the buildings is about the same, but the three-room apartments rent for more than the neighboring six rooms. I know personally that every one of the small but entirely modern and convenient apartments is rented all the time and that ever since they were built the owner of the six room suites has had trouble in keeping tenants.

Aside from influencing the development of space-saving devices, which are revolutionizing interior arrangements, the housing shortage has also had the effect of stimulating invention in new types of building materials and in the perfection of others.

In the SCIENTIFIC AMERICAN of May 28th last there was described in detail the plan of Mr Simon Lake for building small monolithic hollow wall concrete units in centralized factories, the complete unit to be delivered on a special truck to the lot, ready for occupancy. The construction apparently overcomes previous objections to concrete homes in that it is damp-proofed, permits of an infinite variety of designs and does not require the erection and tearing down of costly forms at the building site.

In this connection another small housing unit which has recently made its appearance is of interest. In this case sheet iron is used in the construction which has many novel features. The chief feature of the house is that no nail or hole pierces the galvanized metal, so there are no points at which rust can attack the metal. The outer walls are made of No. 20 gage sheet steel, galvanized and painted, and formed into sections 24 inches wide with a rigid pressed steel stud in the center of each section. These sections interlock with each other and the edges are held in place and reinforced by iron rods, which run through the sections lengthways, holding the roof and eaves securely in place and being bolted at the bottom to angle-iron sills. The roof also is of galvanized sheet steel and together with the outer walls forms a rigid water tight all-steel structure. Inside this shell the finishing is done with ordinary woodwork. Walls and partitions are made of half-inch asbestos wallboard nailed to wooden studding and rafters. As an added insulation against heat and sound all exterior walls are lined with

felt. Under the present selling plan the complete house, 20 by 36 feet containing *four rooms and bath, is sold and erected* complete with plumbing and lighting fixtures for a little less than $2000 The house may be extended lengthwise as desired in two-foot units, but cannot be *made more than one story in height*

For the man who wishes to build a distinctive home from his own plans, there is interest in new building materials and in the improvements in old ones, notably *in stucco construction*

One of the latest materials is a development of the asphalt shingle In this case the asphalt base is made much heavier than usual and a coating of *ground slate pressed on the surface* It is used in large standardized slabs as siding

The latest development in stucco work is the recommendation from the Bureau *of Standards, which is being generally* accepted by builders, that when metal lath is used the customary wood "sheeting be dispensed with and instead one coating of cement be stuccoed on the inside of the wall This completely imbeds the metal lath in the cement, protecting it from corrosion makes the wall more fire proof, and gives other desirable qualities Insulating paper is nailed on *the inside studding and over this are* placed the furring strips to which is nailed the expanded metal lath for the inside plaster finish This method differs radically from standard practise and the *requirements of many city building codes,* which call for a solid board sheeting under the outside stucco but it is backed by scientific investigation

A Newark N J inventor has placed on the market a new stucco base which holds the promise of remarkable results It is in the form of slabs of inch thick porous concrete nearly as light and as strong as wood, which are nailed directly to the studding of the house Only two coats of stucco are then required to finish the wall The inside is plastered as usual

The porosity of the concrete is secured in a most ingenious fashion Small pellets of parafin or some similar material are mixed with sand and portland cement and the mixture spread in slabs over wire mesh reinforcing and allowed to set for a day and a half Then the slabs are placed in an oven and subjected to a high degree of heat The parafin is melted and driven off through the pores of the concrete the fumes caught and condensed by distillation and used again in the form of pellets, and strange as it may seem this heating does not affect the structure of the concrete but merely interrupts the setting process until the slab again cools off The product is surprisingly light and strong It is believed that the only similar product now on the market is *a light concrete manufactured by* a Belgian firm, in which sawdust is an ingredient

While it may appear that this method would make the slabs prohibitive in cost, *the maker claims the finished building,* because the labor item is lower, costs about the same as by any other method of stucco working It is claimed that the insulating qualities of the porous wall are *very marked*

A number of patented stucco mixtures have also made their appearance on the market and qualities are claimed for each Such mixtures are said to be superior to ordinary *cement stucco* and the material is entirely damp proof, more elastic, desirably colored and so on

Since houses are at a premium more attention is being paid to making them *fireproof A scheme has been devised by* a number of manufacturers of metal lath for rendering an ordinary frame building so nearly fireproof that it would be hard to burn it down This is done by the *erection of firestops at all vulnerable* points, as under all bearing partitions and stud exterior walls, ceilings over heating plants and coal bins, at chimney breasts, around flues, back of kitchen ranges, *around stair walls and under stairs.* The plan adds about $200 to the cost of a $5000 house

All in all the man who has waited to build his home until conditions are more *settled can profit by some very remark*able housing developments for his waiting

Tomorrow's Airships

(Continued from page 80)

In this case the figures are based on an airship of 3½ million cubic feet, which can be constructed in England without difficulty by a slight extension of the *existing sheds. This ship is calculated* to have a gross lift of 105 tons and a disposable lift of 68 tons The estimated speed at full power is 75 m p h and the endurance, carrying 15 tons of passengers and freight, 80 hours or 1800 miles

The proposed route to New York from London is via Portugal and the Azores, to take advantage of the better weather conditions, the distance being 3800 miles and the time taken 60 hours. The return journey would be made by a direct crossing of some 3000 miles and time taken would be 50 hours

With four airships working it is anticipated from an examination of weather records that crossings would be practicable on 300 days in the year, and that 200 crossings could be maintained. Fifteen tons would admit of 140 passengers and their luggage to be carried, or 50 passengers and 10 tons of mails.

Synthetic Agriculture

(Continued from page 81)

What used to be called theory has proved to be of the utmost practical importance, so among the practices derived from this knowledge is the inoculation of newly reclaimed land, not with pure cultures, but with soil from a nearby field which had borne a leguminous crop the previous year These bacteria spreading slowly through the soil should be harrowed in, and in no case left exposed to the burning sun This insures a good first leguminous crop where otherwise *failures had often to be recorded*

The climate has not been studied enough up till now in connection with crop production It plays an important part, in so far as it allows the obtaining of higher crops, when full advantage is taken of its action

Machinery and implements are chosen on the principle that only one type is best suited to the work it has to perform *Deep working of the soil is one of the* great assets of synthetic agriculture Sometimes it is necessary to proceed gradually but the final results are better aeration humus, bacteria and feeding elements *for crops* brought deeper, improved water supply, deep rooting encouraged crops suffer less from heat, and closer cropping can be indulged in

Subsoiling has a marked effect on most of the crops, harrowing and especially sowing are more often done too shallow than too deep and the most favorable depth is seldom attained

Rolling and hoeing have most remarkable effects, they are not used to the full extent justified by their usefulness For instance, in summer a crop is brought up rapidly by rolling, but once the tap root down, the surface must be broken to check evaporation. The effect of hoeing has been translated by several people into something tangible like once hoeing equals a shower but twice equals a dressing, but still the dressing value is often left aside.

Transporting Electric Current

(Continued from page 84)

final position The gin pole is usable where the weights do not become considerable With heavier structures, a pair of shear legs may be substituted for the ordinary gin pole. These are two long poles so set as to lean toward each other, thus forming the sides of a tall and narrow isosceles triangle. The feet of these side poles may be secured to a horizontal member at its ends. This complete triangle may then be used much after the manner of the single gin pole.

It is highly important that all preparations be completed by the moment actual hoisting to position begins. It seems that accidents during the actual erection are not so infrequent. A tower may easily drop when erection has reached a point where the tower is at a 45 degree angle If the tower slips at the location of the "hinge," any amount of trouble may ensue, not to say loss of life or limb A good deal of attention has been given to the matter of this "hinge" One of the successful devices consists of a stout iron pipe which is employed as the axle of rotation The tower will naturally have two legs on the ground Over the feet are secured shoes made of angle bars. These shoes are so shaped as to fit well and permit of being bolted to the foot through the regular rivet holes. Each shoe is provided with a steel loop so fixed as to project beneath the sole The hole in these loops is, say, five inches in diameter When the shoes have been bolted in place, the bottom legs of the tower will have two loops, one to each leg, forming, as it were, prolongations of the legs. A 4-inch iron pipe is passed through the two loops. This pipe is of a length to permit, say, 1 foot to project beyond each loop and to form the "hinge" on which the tower is to turn during the erection operation. In order to prevent the pipe itself from slipping sideways on the ground, a loop at the end of a steel cable is passed over each projecting end, and the cable itself is secured at a convenient point on the side from which slippage, if it occurs, is to be expected Pins driven into the ground serve to provide the proper points of anchorage

When a tower is being erected by the shear-leg method, it is important that the erecting operation be not permitted to proceed too far It is said that many towers have dropped because of having been pulled too far over To guard against this, wire rope is attached to the head of the tower and carried back on the side from which movement is to take place Naturally, this line, which is to be used substantially as a guy rope, must yield to allow erection to go on But it must be carefully controlled, and there must be sufficient resistance to prevent the erecting pull from going too far Fortunately, the maximum resistance does not have to be exerted the instant the tower axis becomes vertical There will be no substantial danger of falling over, in the erecting direction, until the center of gravity reaches the vertical plane through the "hinge" This means that the maximum length of the back guy rope does not have to be fixed beforehand with great exactness. The rope should be long enough, but not too long, and there is a considerable margin permissible. Consequently, it is proper to secure the ground end of the rope to a suitable anchorage

A single team is able, under ordinary conditions, to erect a 5,000-pound tower, with a pair of shear legs used in the manner described. If the tower is of double this weight, three teams may be required Naturally, one may use a tractor instead of teams of horses or mules.

The length of spans between towers has been the subject of a good deal of study Experience with very short and very long spans has led to the conclusion that, when everything has been taken into consideration, long intervals between towers is the preferable practice. First cost will sometimes be greater, because of the height and weight of the fewer towers, but the maintenance of lines with long spans is decidedly less. And this is an item that must be considered. Not only is maintenance less, but troubles from interruptions of service are reduced.

IN THIS ISSUE:

DEPTH BOMBING FROM THE AIR
WHERE OIL OCCURS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY SCIENCE INVENTION MECHANICS

MOVING AN ENTIRE SECTION OF A TOWN TO MAKE ROOM FOR MINERS (See page 95)

Vol. CXXV No. 6
August 6, 1921

Published Weekly by
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Price 15 Cents
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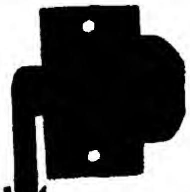

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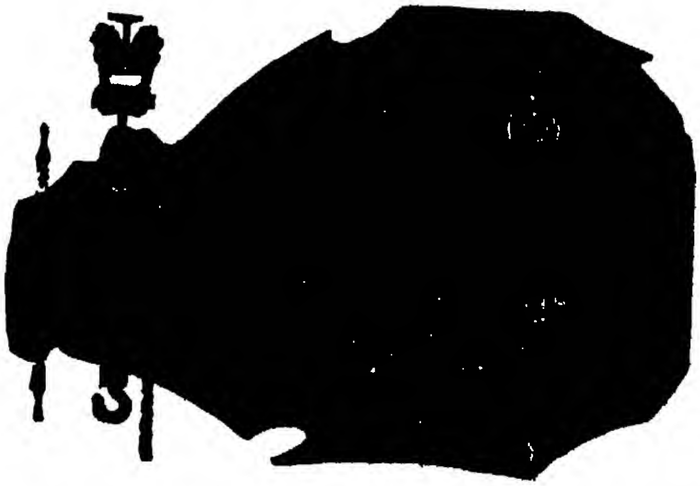

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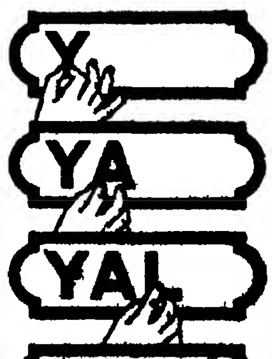

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SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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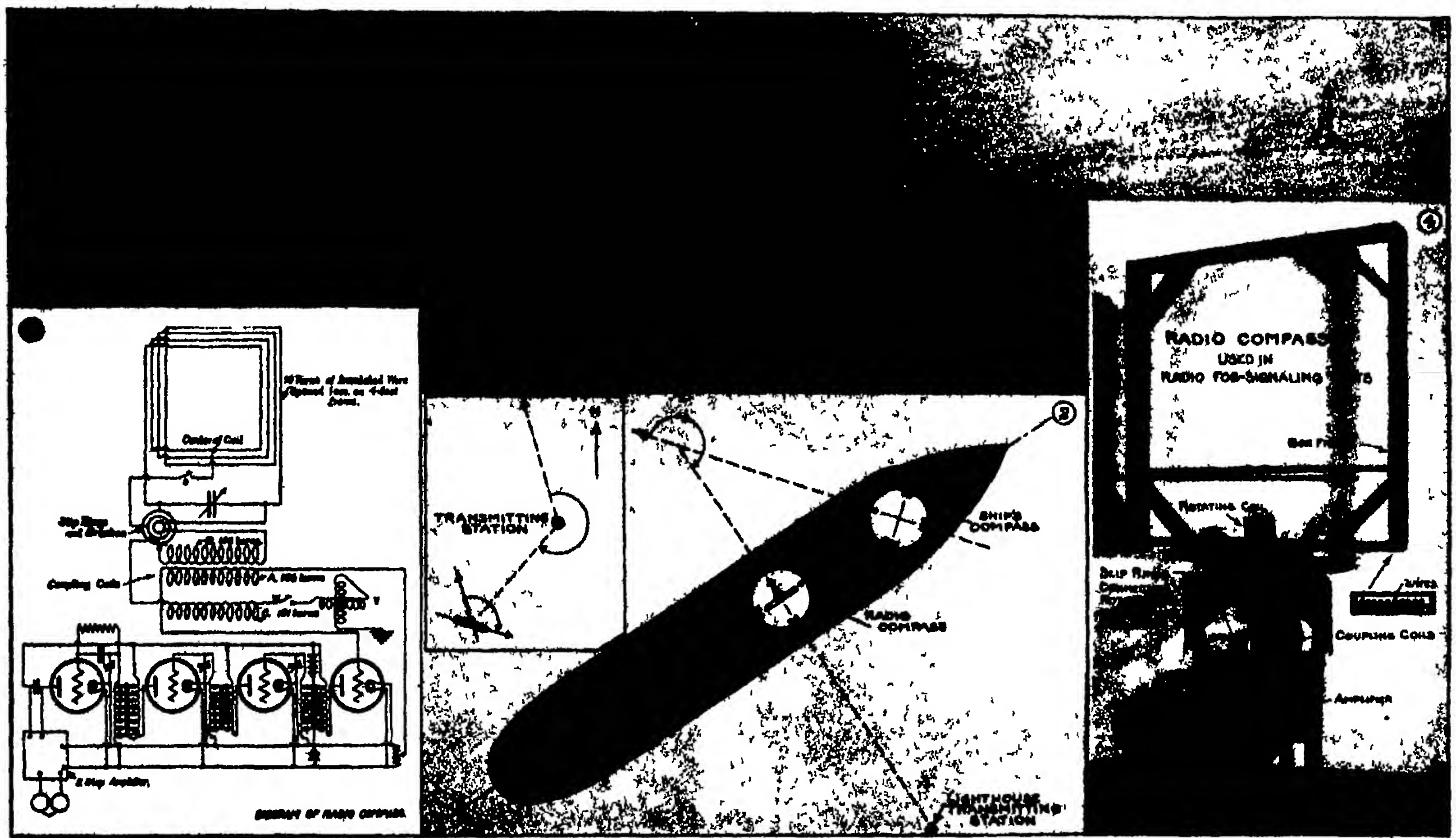

1. Steamship approaching the coast during a fog and locating the hidden entrance to a port by means of the radio signals transmitted from the two lighthouses seen dimly to the right and left of the vessel. 2. Diagrammatic presentation of the manner in which the magnetic compass and the radio compass are used in conjunction with wireless signals transmitted from a lighthouse. 3, Scheme of wiring employed in a typical radio compass installation 4 Typical radio compass outfit as used by the U S Lighthouse Service.

Details of the radio compass now used in navigating ships in safety during foggy weather

The Radio Compass and Navigation

By Robert G. Skerrett

PERHAPS it is too much to say that fog will be robbed of all of its perils to the navigator But in view of recent developments in the radio compass it may be claimed that blanketing mists or driving snow will hereafter offer fewer dangers to the mariner In this work for the promotion of nautical security, the Bureau of Lighthouses and the Bureau of Standards of the U. S. Department of Commerce have conjointly made valuable and important contributions of late.

As is pretty well known, the effectiveness of the radio compass depends fundamentally upon a principle discovered in the early days of wireless telegraphy That is to say, it was then revealed that the radio waves would set up the liveliest response in an antenna or loop when either of these receiving apparatus lay parallel to the direction in which the oncoming waves were propagated, while, on the other hand, this reaction was found to be weakest when the antenna or loop was set across or at right angles to the arriving radio waves.

Simple as this basic principle is, it has taken years to make the radio compass as reasonably accurate as it now is. One of the difficulties has been to devise ways to neutralize what is termed "re-radiation" emanating from "accidental" antennae formed by adjacent wire rigging, steel masts, smokestacks, derrick booms, boat davits, ventilators, etc These have a tendency at times to produce secondary wireless waves of sufficient energy to vitiate the directive influence of the original waves. Today, however, thanks to persistent research and improvement, a wireless compass can be calibrated just as a magnetic compass is compensated to offset the influence of local masses of iron and steel The experiments of the two Bureaus of the Department of Commerce have made it clear that much can be gained in receptive precision by adopting a fixed wave length for fog-signaling use and then calibrating the radio compass accordingly

During the World War, the United States Navy did much to develop the practical application of the radio compass, and that arm of the national defense called into being a number of shore stations which it has since operated successfully and helpfully These radio stations work in groups and are provided with radio compasses with which, on the request of a ship, is determined the position of that craft in the offing. This information is transmitted to the vessel by wireless telegraphy, When two stations coöperate, it is possible, by plotting the directional line from each, to obtain a cross bearing which establishes closely the location of the inquiring navigator To be effective, the craft must be equipped to send a prescribed signal to the shore stations and then must be able to receive and to translate the response which is in code

The U S Lighthouse Service has sought to develop a system which would function in the reverse order, *i.e.*, permit the mariner to ascertain his position without sending any signals In short, render it feasible for a vessel carrying only a modest receiving apparatus, and without the aid of a wireless operator to thread her way confidently through an enveloping fog This has been achieved by installing at certain lighthouses and on some lightships transmitting apparatus for the propagation of prescribed wireless signals at fixed intervals—the periodicity and character of these serving to identify the dispatching source

As will be readily appreciated the radio waves during hours of low visibility are counted upon to perform the same guiding service that the beacons would discharge in dark hours and while the atmosphere is clear As soon as fog interferes or thick weather obscures the vision of the man on the bridge, the system enables selected lighthouses and light vessels along the coast to send out continuously distinguishing radio signals. The

(*Continued on page 105*)

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The Bombing Tests and Our Naval Policy

IF the people of this country and their Congress interpret correctly the results of the recent bombing tests off the Virginia Capes, they will demand the immediate reinsertion in the Navy Bill of the two naval aircraft carriers which were so strongly recommended by the General Board

The dramatic sinking of the "Ostfriesland," which went down eighteen minutes after a mortal blow was struck by a single bomb, dropped from an Army Martin bomber, does *not* prove that the day of the big battleship has passed It would be a grave misfortune if this event served to create in the public mind any such belief As a matter of fact the sinking proved nothing of the kind The one fact which it did establish was that, if a 2000-pound bomb is detonated at a proper distance below the surface of the water and in close proximity to the submerged portion of an unguarded and helpless battleship, which is ten years old and therefore at the obsolescent stage of her life, she will be sent to the bottom

Furthermore, there is little doubt among those who witnessed the bombing that, if a bomb of 2000 1000 or even 600 pounds' weight scores a direct hit upon a ship, great damage will be done to her equipment, particularly to her lighting and electrical and voice-pipe communications, and a large part of her personnel will be disabled by shock

The one great outstanding lesson is this—that since aerial bombs can work much deadly havoc on a dreadnaught it is imperative that a fleet be provided with every known defensive means for driving off or destroying the enemy bombing machines before they can get within striking distance of the battle line

There is but one absolutely effective protection of this kind, and that consists in the provision for every fleet of an airplane force, sufficiently powerful to meet the enemy attack and obtain ascendency in the air, early in any fleet engagement Every capital ship should carry upon its turrets at least two fast fighting or pursuit machines, and two observation and bombing machines capable of being launched by a perfected launching device of the kind which has formed the subject of much experimental work in our Navy If our fleets are to be in a position where they can obtain mastery of the air, it will be necessary to go further than this and provide for each fleet (one for the Atlantic fleet and one for the Pacific fleet) a large and fast airplane carrier capable of housing several observation and bombing machines and fast fighting scouts To provide the needed carrying capacity, and sufficient width and length of decks for flying off and flying on these ships should be at least 800 feet in length and they should have engine power sufficient to enable them to work up quickly to a speed of 32 knots.

We have no such fighting force in our Navy today therefore this much at least is certain—that if, tomorrow, our battleships were fighting a line action against an enemy that possessed such an air force as we have just described, he would quickly establish command of the air, and his bombing machines would be free to pass over our lines, where they would be subject to no greater interference than would come from the three-inch anti aircraft guns on our vessels.

Now, talk with any experienced Navy or Army bombing man, and he will tell you that he cares not a snap of the fingers for so-called anti aircraft fire He will tell you that if a plane should be hit it is more a matter of luck than good shooting In this the statistics of the war fully bear him out For it took only a little less than 1000 shots to score a damaging hit.

A strong force in the air, with airplane carriers in which they can nest, repair and replenish, is the most crying need of our Navy today That is the urgent lesson taught by the recent sinking of the German warships off the Virginia Capes

The Literary Commentator

EVERY language must have its classical literature—though the persistence with which The Vicar of Wakefield retains its place on the list of the College Entrance Examination Board may sometimes cause one to wonder by what test and under what authority the list of classics is compiled Nevertheless, classics there must be, and careful, detailed study of these classics The man who makes this sort of thing his lifework has of course a different viewpoint upon such study from that possessed by the man in the street. But even granting this, and allowing the professor of literature all the latitude that is by right his, we wonder whether analysis of the text of the classics is not carried to extremes of absurdity?

Reference to any edition of Shakespeare or Milton that bears the earmarks of conscientious editing will bring to light cases where this question must, at least by any but a classicist, be answered in the affirmative. Much comment will properly be offered on the style, the grammar, the choice of words. The growth of the language will have more or less light thrown upon it by a comparison of the terms and the expressions employed with those current a hundred years sooner or a hundred years later All this is defensible, and more It is admittedly interesting to identify the incidents in the life of Goethe which led to this, that, or the other great passage in his works It is pertinent to show sentences in Shakespeare that reflect the influence of Bacon or of Spencer, or vice versa It is quite in order to take an obscure metaphor in Milton, and show how it refers to a chain of incidents in the life of a patron or a friend But the assiduous commentators do not stop here

When we turn the average classicist loose upon his Cicero or his Shakespeare or his Schiller every word of the original is weighed in the balance with the utmost care against all the possible alternatives which existed, and the precise reason why the author chose the one he did is set forth with learned gusto We have seen more space and time thus lavished upon the justification of a single Shakespearian conjunction than we would be willing to believe the bard of Avon had used up on the entire scene We have seen more different accountings for a curious Miltonian turn than the blind poet could possibly have imagined, if he had lain awake o' nights to worry about it In general, we have seen the classical critics put more heavy thought into word after word, sentence after sentence, passage after passage, than it would have been humanly possible for the original author to have employed in the same place We have seen them spend much valuable time and use up a vast deal of more or less valuable space in distorting with labored comment what is on its face a casual passage of the original If this were done merely in the desire to search out the principles of good composition, as unconsciously put into practice by a master, we would have no objection. But the tenor of the commentators' remarks precludes this supposition He sincerely believes he is reconstructing the master's state of mind

The classicist, unfortunately, is in sufficient disrepute in this 'practical' age to make it quite superfluous for him to pile up absurdities of his own to add to his low standing in the eye of the work a day world. Could he not, by some chance, refrain from such studied nonsense as marks so many of his comments on the text of his original? To his fellow classicists they may give the atmosphere of deep erudition, to nobody else do they stand for anything but the sheerest nonsense.

Every Man for Himself

IN the ruthless destruction of our forests and the extravagant and wasteful methods by which we are using up the natural resources of America, we have been following a policy which has been truly described as one in which it is a case of "every man for himself and the Devil take the hindmost."

The most discouraging fact about the whole situation is that, in spite of endless warnings and the carefully prepared governmental statistics showing the rapid depletion of our resources, particularly of our forests, nobody seems to be very much disturbed and the movement to correct this abuse is apparently making very slow headway

Perhaps in making the above statement we are speaking too broadly, but of this we are certain—that it is impossible to paint in too dark colors and denounce too strongly the ruthless way in which the forests of this country continue to be swept away. Oil and coal once consumed are gone forever, and a mine worked out and an oil field pumped dry have been stricken off the list of the nation's economic assets. Not so, however, with the magnificent forests of this country For the conditions are such that by judicious and intelligent replanting, it is possible to make our forests perpetual—so marvelous is the recuperative power of Nature in the matter of the perpetuation of forest growth, if only she be given a chance. If tree planting kept pace with tree cutting, Nature would take care of the balance between demand and supply

That the thing can be done successfully, and for generation after generation, has been proved in the highly cultivated lands of Europe, where the people seem to be possessed of a forethought and patience that are sadly lacking among the inhabitants of the new world—lacking, at any rate, in this matter of forest preservation. In writing thus, we are not unmindful of the work which is being done by the Government through our Department of Forestry, but if we are to get adequate results, the work of the Department must have the moral backing of the country as a whole The way in which our forests have been and are still being cut down is an exhibition of a callous and very ugly selfishness. In this matter we must realize that there are duties which we owe to posterity The forests belong to the people who shall come after us just as much as they do to us, and if we cut them down without provision for their permanent continuance, we are robbing posterity of a priceless possession and a heritage to which they have every moral claim

In conversation recently with a Persian diplomat in Washington, we asked him whether the district of Persia in which he lived were well wooded. "Not a strip of timber," he said "Just miles of absolutely barren, sun-baked mountains. Once, these ranges were heavily clothed with timber, but the Persians through the centuries have done what you are doing now in America—cutting down their timber without replenishing it."

Representative Davy, of Ohio, in a recent speech before the House of Representatives, spoke to the same point when he said "This question of reforestation is of monumental importance America cannot continue to exist as a virile, forward-moving nation unless we protect what we have and start to build up that which we have so ruthlessly destroyed We cannot afford to be a nation of Vandals much longer America must reforest, or she will have to drink the bitter dregs of national decline and impotency"

Sir Robert Hadfield Wins the John Fritz Medal

THE fine catholicity of spirit which has always characterized our American engineers in their award of the John Fritz Medal has been manifested in the award of this distinguished token this year to the well known British engineer and metallurgist, Sir Robert Hadfield Sir Robert is perhaps best known to the world at large through the application of his principles to the manufacture of armor-piercing shells, and through his methods for the prevention of segregation and piping in the casting of ingots, both of which have from time to time been described and illustrated in this journal. The John Fritz Medal was formally handed to Sir Robert Hadfield by Mr Ambrose Swasey, as chairman of a delegation of American engineers who had crossed the Atlantic for the purpose. It is a well deserved recognition of the services he has rendered to engineering practice and industry by the discovery of manganese steel. The Medal is the highest honor American engineers can bestow, and it comes with the full force of the American engineering profession behind it.

Electricity

Liquid Resistance Starters.—Lower in first costs and maintenance costs, liquid resistance starters recently introduced in England are said to possess many advantages over metallic starters. Easily installed, they can be interchanged from one motor to another of a different voltage, with slight alteration to liquid density to suit the new rotor characteristics. No damage is possible through overloading. For certain duties, liquid resistance starters are claimed to be the only practical starters. These starters are totally enclosed, insuring cleanliness and preventing evaporation of the liquid. An easy, gliding starting of the motor is effected without jolts or jerks.

Ontario's Electric Scheme.—After an investigation covering 23,000 farms, it is estimated by the Ontario Government that at least 10,000 farms will install electricity for lighting and power purposes as soon as the necessary transmission lines are provided. It is the intention to construct 1000 miles of these lines during the next five years. The Provincial Hydroelectric Power Commission today is serving about 250 municipalities, operates 13 distinct systems scattered over the province, and distributes 305,000 horsepower of hydroelectric energy. With the early completion of the Queenston-Chippewa plant on the Niagara River, 110,000 horsepower will be available for distribution. With complete equipment installed the plant will have an ultimate capacity of 525,000 horsepower.

An Interesting Electrical Nightlamp has made its appearance in England. It consists essentially of a spiral about 1½ inches long and 1 inch in diameter, which is arranged vertically in a bulb filled with neon gas. Light is produced by a discharge from this spiral in a similar way to the Moore light or mercury vapor lamp, and the resulting illumination is of a beautiful orange color. The rating of the lamp is about 5 watts, and its life is said to be considerably greater than that of the ordinary metal filament lamp. It is supplied for alternating current circuits from 110 volts up, and for direct current circuits from 150 volts up. Lamps of this kind should find a useful application in nurseries, dormitories, hotels, theaters and so on where a light of low current consumption is required.

The Radio Appeal.—There was a time when wireless telegraphy appealed only to the so-called amateur, and his interest was rather directed toward the technical end than the mere pleasure of gathering messages out of the air for whatever they were worth. With the establishing of Government radio reports and a number of radio telephone broadcasting stations throughout the country, radio reception becomes a matter of considerable interest to everyone, especially persons in remote districts who are ordinarily more or less out-of-touch with the world at large. Today the farmer, the business man in the small village, the camper and others can use a simple receiving set and keep posted on what is going on in commerce, politics, sports, stock and bond market, and even religion.

The Longest Telephone Cable In Existence has been laid between East Prussia and the German mainland, in order to get around the wedge-shaped territory assigned to Poland. This cable has been laid to avoid international difficulties from overland telegraph and telephone lines. It is about 100 miles in length and contains six telephone pairs and three single telegraph wires. Each of the twelve telephone wires is covered with a double layer of annealed iron wire. All conductors are paper-insulated. Owing to the depth reaching some 250 feet at its greatest point, a double lead sheath, a double spiral of steel wire, and finally an outer interlocked steel armoring have been used. Every 1½ miles a water stop has been built into the cable to localize any entrance of water into the cable in case of break.

Getting Along Without Platinum has come to be the rule rather than the exception. With the shutting off of the platinum supplies in Russia, and with the ever-increasing shortage and soaring prices of this precious metal, electrical manufacturers have had to develop ways and means of getting along without it. Fortunately, suitable wires, such as alloys of iron and nickel, and nickel-steel coated with copper, have come to be generally used for the leading-in wires of incandescent lamps. Such wires have the same co-efficient of expansion as glass and therefore make a good seal. Heretofore platinum has been used for this purpose; obviously, at the present high prices of platinum each incandescent lamp might have as much as ten cents worth of platinum wire, which would materially add to the cost of such lamps. The use of platinum for contacts has been largely abandoned, either silver or tungsten being used. The latter metal, because of its hardness, is very difficult to work and it is not easy to make a satisfactory point-contact with it.

Astronomy

Meteor Observers in Czecho-Slovakia.—A central office for collecting reports of meteor observations in Czecho-Slovakia was established in May, 1920, at Reichenberg, Bohemia, by Arthur Beer. A noteworthy feature of this undertaking is that 14 branch stations have been established in different parts of the country for the purpose of gathering information regarding casual observations of meteors, as distinguished from those made by regular observers.

Small Clouds on Jupiter.—Prof. W. H. Pickering, in a recent address before the British Astronomical Association, recalled the fact that during his observations at Arequipa he noticed that the surface of Jupiter, instead of being composed of uniform bands of yellowish white or brown, really consisted of an enormous number of extremely minute reddish brown clouds, seen upon a perfectly white background. The effect of belts was produced where the cloudlets were numerous, and the light spaces where they were scarce. He compared the appearance of these spots to the well known "rice grains" on the sun. Their lengths lay in the direction of rotation of the planet. He said he had since observed the cloudlets in Jamaica, and they have been seen in England by Phillips and Steavenson.

Barometric Effects in Meridian Circle Observations.—As the inclination of planes of equal barometric pressure in the atmosphere varies, there should be a corresponding variation in astronomical refraction, affecting the apparent positions of stars. There has been a good deal of discussion as to the amount of such displacements, especially in connection with meridian circle observations. The subject is discussed in a recent paper by C. C. Wylie, who has examined a large body of astronomical observations for this purpose, and made comparisons with the barometric gradients as scaled from the daily weather maps of the Weather Bureau. He finds "by every method of attack, that the effect of the barometric gradient must be exceedingly small, so small that observers need have no fear of its producing systematic errors in their routine work."

Measurements of Stellar Diameters.—The sensational feat of measuring the diameter of Betelgeuse, accomplished last December at the Mount Wilson observatory with a 20-foot interferometer attached to the 100-inch reflector, has now been duplicated in the case of Arcturus, which was measured by Mr. F. G. Pease with the same apparatus on Feb. 12, 1921. With the mirrors of the interferometer 19 feet apart, the interference fringes were invisible, indicating an angular diameter of 0.024 sec. for the star. From the parallax of Arcturus, which is known with a considerable degree of certainty, the star's diameter is computed to be about 19,000,000 miles. In a recent report on the measurement of Betelgeuse Mr. Pease states that observations made in December indicate the possibility of measuring Alpha Ceti, Alpha Tauri and Beta Geminorum by this process. Concerning Betelgeuse he says the uncertainty of the recent measurement is about 10 per cent. The effect of a possible darkening at the limb, which has been disregarded, would tend to make the measured results too small.

A Remarkable Spectroscopic Binary.—The brighter component of the well-known visual binary Tau Cygni was found to be a spectroscopic binary by Barrett in 1908, but its period was unknown until recently. On the night of July 16, 1920, Dr. J. S. Paraskévopoulos, of the National Observatory of Athens, took a series of photographs of the star's spectrum at the Yerkes Observatory showing that its period is only 3 hours and 25 minutes, the shortest period heretofore found for any spectroscopic binary. By assuming the surface brightness to be the same as the sun's, since it has nearly the same spectral type, the radius of the principal component is found to be larger than the distance between the two components. Neither the hypothesis of a pear-shaped body nor an explanation along the line of the pulsation theory appears to fit this case.

True North by the Stars.—While everyone knows that the Pole Star is not exactly at the north pole of the heavens, everyone does not realize that, in the course of the small circle which it describes about the pole, it is exactly north of us twice every 24 hours. Obviously there must be some other star so situated that when a plumb line cuts it and Polaris the latter is in position to show the true north. Of the easily distinguishable stars, the best for the purpose are Zeta Ursae Majoris and Delta Cassiopeiae—both of them located below the pole. The American Nautical Almanac, Table VI, page 700, gives full information on this method of determining the true north, including the exact interval of time one must wait, after Polaris comes vertically above one or the other of the stars named, until it occupies a place exactly on the meridian.

Automobile

A New Rust-Proofing Process, which has been successfully used for small automobile parts, has been evolved in a British research laboratory. This consists in boiling the articles to be treated in a solution of hydric-phosphate of iron which produces a dark gray finish practically immune from the attack of rust. It is said to be very much more rapid than Coslettising and has no effect upon either the strength or temper.

The Municipal Gasoline Hearse.—In Munich, Germany, hearse service has been "communalized" and will be carried out by means of gasoline automobiles exclusively in the future. Heretofore, the service has been partly in the hands of livery men, who furnished horse-drawn hearses and partly of the city which owned a number of electric hearses. The change from electric to gasoline hearses was due to the fact that the electrics were about worn out.

Reclaiming Used Oil.—A new company has been organized in London with the object of reclaiming stale lubricating oil. The waste oil can be bought at prices ranging up to about $100 per ton and in some cases can be had for the cost of collection. It is planned to establish immediately a plant near London with a capacity for treating 50 tons per week, which, it is believed, can be easily collected in London and other plants in the various large cities of the Kingdom.

To Clean Running Boards and Floor.—From the looks of the number of stained and dirty running boards on the cars in use it would seem that few motorists know how to clean them properly. While soap and water will remove the mud and some of the dirt, the running boards will dry with the grease spots and other marks as plain as before. These can be entirely removed and the covering made to look like new simply by wiping them with a clean rag saturated with kerosene. This is also the best way of cleaning the floor boards.

Pre-Heaters An American Feature.—European engineers have not gone nearly so far as we have in the matter of applying heat to the incoming charge, from descriptions of European cars that have recently reached us. This may be in part accounted for by the fact that none of the large European industrial countries has the low winter temperatures that we have to contend with but the chief reason undoubtedly is that the gasoline sold in Europe at the present time does not have the low end point that ours has, and vaporizes at lower temperatures.

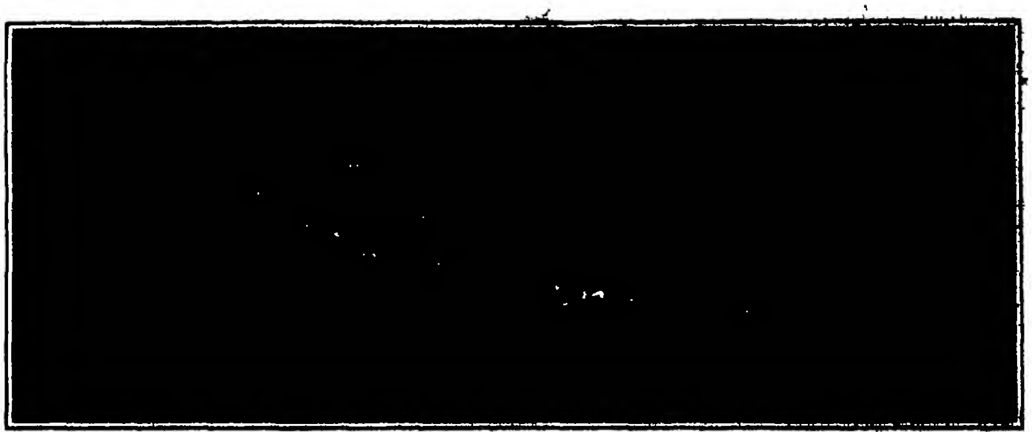
Narrower V-type Engines.—Lancia, the automobile manufacturer of Italy, has evolved a construction, recently patented in England, by which the width of V type engines is decreased. In a twelve cylinder engine, for instance, the axes of the two sets of cylinders do not meet at the center of the crankshaft but a distance below the crankshaft about equal to the length of the connecting rod. The axes of the connecting rods at dead centers make an angle of 20 degrees and the cranks of each pair of cylinders make an angle of 40 degrees. In this way it is hoped to obtain a fairly good balance.

Better Seated Bonnets.—A recently devised engine-bonnet lock of the eccentric type is claimed to permit of the use of a much stronger spring than is used on the present type of lock and still be readily operated with one finger. The eccentric locking element is associated with the bonnet catch in such a way that a two-point bearing of the same is secured, the intention being to prevent rattling and side motion of the bonnet. The bonnet lock is adjusted by rotating the body on the anchor bolt. This lengthens or shortens the lock, as desired. Each time the lock is released the anchor bolt is automatically forced into engagement with an absorbent oil saturated pad, contained within the lock body. This lubricates all moving parts.

Natural Gas Gasoline.—By the addition of the highly volatile natural gas gasoline it is possible to make use of the gasolines of low volatility in even cold weather. The failure of natural gas through Ohio and Pennsylvania which are the two leading natural gas states, is of course going to have a similar effect on the natural gas gasoline industry. An authority has pointed out the ever increasing use of the absorption methods of manufacturing natural-gas gasoline. This, he stated, is a result of experiments during the war on the high absorption qualities of charcoal. This development is going ahead very rapidly and plants using it are running at 50 to 75 per cent efficiency, which is higher than by previous methods. It is also found possible by this method to extract the gasoline from natural gases which are very lean in gasoline and from which it is practically impossible to get results with the compression method which was previously used.

Depth-Bombing from the Air

Results and Lessons of the Sinking of the "Frankfurt" and "Ostfriesland" Off the Virginia Coast



"Ostfriesland" sinking, quarterdeck submerged; heavy list to port

THE United States Navy is to be congratulated upon the success which attended the recent elaborate air bombing tests, extending over a period of several weeks, in the course of which several submarines and destroyers a modern scout cruiser, and a 22,000-ton dreadnaught were sent to the bottom These ships were allocated to the United States as our share of that portion of the surrendered German fleet which was not sunk at Scapa Flow or was salvaged subsequently to that sinking. These ships were allocated with the understanding that they were to be completely destroyed before the close of August, 1921 The Navy decided that they would destroy them under conditions which would simulate, to some extent, the conditions of actual warfare The plan of operations contemplated first, an attempt to destroy the ships by bombing from the air, and secondly, should the bombing fail to put them down, an attack by gun fire Should both of these efforts fail in the case of any ship, a wrecking crew was to be sent aboard and the vessel was to be sunk by high explosives placed within her hull

Many months ago, when these plans were formulated and before the discussion as to the relative value of bombing planes and battleships had grown to its present dimensions, the Navy Department, in a fine spirit of cooperation with the Army requested the Army Air Forces to join them in these bombing attacks. We wish to take this opportunity to contradict the popular impression which unfortunately the daily press has done so much to develop, that there was any spirit of rivalry or fierce competition between the two forces. As a matter of fact, the Army greatly appreciated the opportunity thus presented, and the cooperation between the two was marked by good sportsmanship and perfect military coordination

Conditions Were Highly Favorable for the Attack

If we wish to get a true perspective of these experiments, we must bear in mind and it should be emphasized at the very outset, that the conditions under which the bombing was carried out were purposely made as favorable as possible for the attack It should be understood that never again except in the event of extreme carelessness and neglect, will any airplane force be able to fly, at its own chosen height and in its own chosen weather, across a fleet of anchored ships which has no defense what ever against the enemy If you were to ask any of the bombers of the attacking air force he would bear out the above statement and tell you that from his point of view he had every possible condition in his favor

To particularize we may mention, first that the most successful approach to the target is one that is made with the target dead to windward, and in every case during the three days that we were witnesses of the bombing, the attack was made up the wind In an actual engagement such freedom of choice would not be possible

Secondly, each flight of planes was permitted to pass over the target and withhold its bombs, if the captain did not consider that the position was ideal for releasing the bombs, in fact, a flight would sometimes pass two or three times across the target before it had made the necessary corrections and considered itself in the best possible position. This, of course, would be impossible in actual battle, where the opposing enemy craft would be in the air and a barrage of anti-aircraft shrapnel would be built up against the attack

Direct hit on "Frankfurt"; note splash of fragments

Thirdly, the attacks were made only in favorable weather Low lying clouds, a heavy haze and the approach of twilight were sufficient to call off the operations. In wartime, of course, the attacking force would have to take its chances of adverse wind and weather and poor visibility

Fourthly, the targets were anchored—a point of immense advantage to the bomber, when using his sights from the plane above. In an actual fight battleships would be moving from 17 to 25 knots an hour, cruisers from 25 to 35 knots, and the quick helm, which characterizes all modern warships would enable a ship to make a change of course as soon as she saw the bombs let loose by the enemy. Zigzagging may well prove to be one of the most effective defenses against aircraft bombs, particularly against those which are launched from high altitudes.

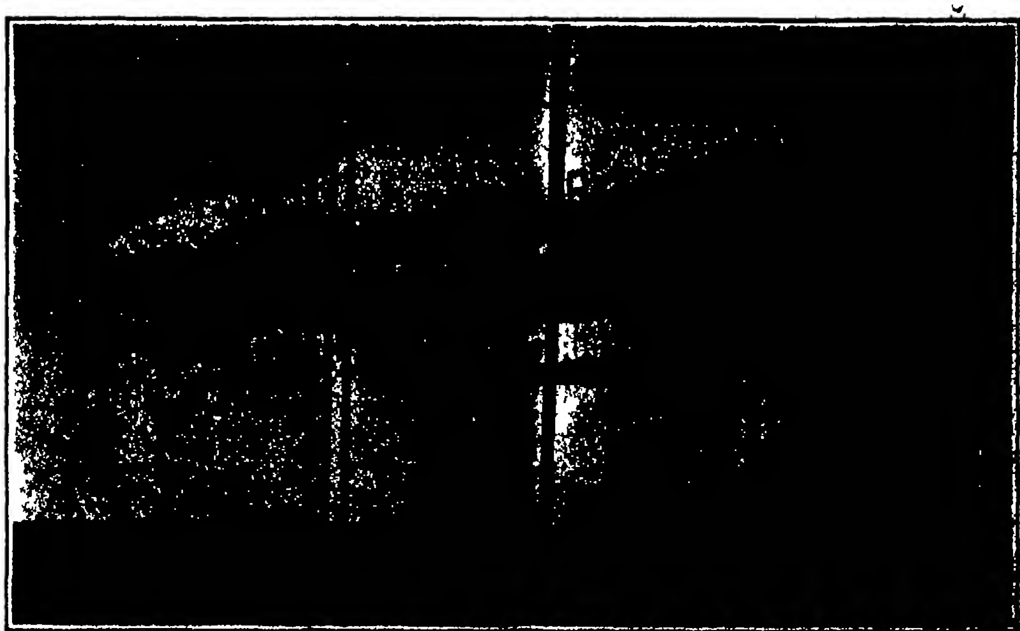
Lastly, there were no opposing craft in the air. The fast fighting scout is master of the heavy bombing machine and, unless the latter is protected by her own scouts she will be sent down before reaching the target.

High Percentage of Hits by the Bombs

Having cleared the air by the above statement of the favorable conditions under which the attacks were made, we hasten to state that the work done against the "Frankfurt" and "Ostfriesland" was excellent. The Army and Navy bombers are to be congratulated. Due largely to the fact that they were working off an old stock of English bombs, a large percentage of the Navy shots proved to be "duds," and consequently their work did not make such a dramatic showing as that of their confreres of the Army We remember one Navy flight which let fall half-a-dozen bombs that formed a beautiful pattern around and on the "Frankfurt"; but not one of these bombs detonated. Without having the exact figures at hand, we think it is safe to say that fully 50 per cent of the bombs either made direct hits upon the target or dropped sufficiently near to have a damaging effect upon the submerged hull of the ships. When we remember that air bombing is, even today, a comparatively new art, and that the sighting instruments are considered to be in the experimental stage, we feel justified in predicting that before many years have passed, bombing from the air, even at much greater altitudes than the 1500 to 1700 feet employed in the recent tests, will take on something of the accuracy of gun-fire. It should be remembered, furthermore, that about the last man to play safe in warfare is your air pilot. After seeing a single 2000-pound bomb crushing in the underbody of a battleship as though it were an eggshell, it is certain that under the stimulus of a great battle, upon which the fate of a nation depends, there will be found many an airman who will not hesitate to dive down at 200 miles an hour, until he is within point-blank range, and place his bomb in just the right position alongside the enemy to sink him, and sink him quickly

Direct Hits More Destructive to Personnel Than to Ship

During the tests of July 18th against the "Frankfurt," which we witnessed from aboard the battleship "North Dakota," at a distance of 1800 yards from the target, it was clearly demonstrated that however much destruction bombs of 250 to 600 pounds' weight might work if they made direct hits upon the ship, they would not suffice to sink her. It was necessary to determine a direct hit [illegible]



The old and the new. A blimp, out for bombing observation, and below, Admiral Dewey's flagship "Olympia," 30 years old, still in commission and capable of 18 knots

...umn of red flame 30 feet in diameter in the case of the larger bombs, which would be followed a few seconds later by the snappy snarling report which is characteristic of high explosives. Sometimes, at the burst, the surrounding water would be flecked with the splash of fragments of shell and the shattered woodwork of the ship's decks. More often, when the smoke had cleared away it would be impossible to detect any material damage even through the most powerful glasses. The most dramatic bit and the one with immediately visible results was made by a 600-pound bomb which passed through the super-structure deck of the "Frankfurt," amidship, and by the force of its explosion lifted the deck and bent it over the side of the ship. As we looked at this through the glass our thoughts went back immediately to the sinking of the Maine and to the remarkable way in which the foredeck was lifted up and curled back upon the super-structure in the great explosion at Havana. The bombs failed to penetrate the protective deck of the Frankfurt and apparently did no great harm to the shell plating of the ship above water. They failed to start any serious leaks during the first several hours of bombing, and this in spite of the fact that the later bombs dropped were of 600-pound weight. So well did the cruiser stand up under this attack that it began to seem doubtful whether she would be sent down before the day was over. The fatal blow was delivered on the starboard bow and not far from the ship's hull. The detonation was heavy, the hammer blow of it being felt through the water by our ship which at the time was over 2000 yards' distant. There was a big upheaval of water which fell mainly across the ship, and when it had drained off, it was seen that the bow was steadily settling and the stern rising above its normal flotation mark. Twenty minutes after the fatal bomb had crushed in the side of the "Frankfurt," she disappeared.

Remarkable view from airplane of a direct hit on "Frankfurt." Note the characteristic dark smoke of a hit and the splash of scattered fragments, blown from the upper works of ship

Sinking of the Dreadnaught "Ostfriesland"

The program of the attack upon the dreadnaught "Ostfriesland" called for bombing first with 300-pound and then with 600-pound bombs. If these failed to sink the ship she was to be bombed with 1000 pound bombs. If she were still afloat, an attack with a specified number of 2000-pound bombs was to be made. If she survived these, the "Pennsylvania," flagship of the Atlantic Fleet, was to try to put her under with salvos of 14-inch shells at a distance of not less than 18,000 yards or nine nautical miles. If the resistance of the ship was equal even to this final test, a party from the "North Dakota" was to go aboard, place large charges of TNT on her bottom and sink her. The confidence in the modern system of anti-torpedo and anti-mine internal construction was such that there were a large number of officers and men of the fleet who believed that, battered as she might be in her upper works, the "Ostfriesland" would succumb only to the well placed salvos of the "Pennsylvania."

The "Ostfriesland" a Well-Protected Ship

To get the full significance of the sudden destruction of the "Ostfriesland," it should be clearly understood that in respect to internal subdivision she was a well protected ship, completed in 1911. Since the surrender to the German fleet, expert officers of the British and our own service have made a [illegible] of German battleship construction and it is agreed that in underwater subdivision as a protection against mine and torpedo, the Germans were somewhat ahead of contemporary ships. The Ostfriesland is by no means out of date, as may be judged from the fact that she

Bomb from Navy Martin bomber bursts under water near starboard bow of "Frankfurt"

was a contemporary with the latest of the British 12 gun and the earliest of the British 13.5 gun dreadnaughts, and also with our own dreadnaughts "Utah," "Florida," "Arkansas" and "Wyoming." Within her outer shell she had longitudinal bulkheads including one armored bulkhead of a tough ductile steel designed to bend without breaking under the impact of high explosives. Such at least was the design and as far as we know she was built accordingly. At any rate the Ostfriesland has it to her credit that in the flight back to Germany after the battle of Jutland she struck a mine and nevertheless reached port under her own power. A sister ship is credited with having received during the same battle the blow of four 15 inch British shells in addition to being twice torpedoed. This vessel also reached port. An important feature in her construction, which is of great importance in considering the quick sinking of the vessel, is that her bulkheads were not pierced by watertight doors; in other words communication from compartment to compartment was up and over. It is the consideration of these facts which leads us to believe that the 2000 pound bomb which was detonated a few feet from her port quarter must have opened up a section of the underbody of the ship far greater than would have been blown in by the detonation of a torpedo or a mine.

How She Went Down

The bombing of the Ostfriesland was set for Wednesday and Thursday, the 20th and 21st of July. Due to unfavorable weather conditions the first attack did not start until noon. It was carried out with 600 pound bombs which were well placed, some of them aboard and some not far from the ship. After two direct hits the destroyer "Harding," from which we observed the test, steamed in alongside the Ostfriesland and even from the distance of 100 yards it was impossible to note any external effects from these explosions. They had penetrated the upper decks and burst above the protective deck—which of course they failed to affect. On reaching the scene of operations on the morning of the 21st it was noticed that the "Ostfriesland" was about two feet down at the stern and it was evident that a slow leak had been developed by the bombing of the previous afternoon. During the early morning of the 21st attacks were made by five Army Martin bombers which dropped 1000-pound bombs. These failed to make any appreciable difference in the submersion of the ship. It had been intended to try the penetrative effect of 14-inch naval shells dropped from naval bombers but, due to a change of program, five Martin bombers and a Handley Page machine came out from Langley Field carrying 2000 pound bombs. Orders had been given to endeavor to place these outside of the ship and as near to her hull as possible. The work of destruction is believed to have been done by two of these half dozen bombs—namely the fourth and fifth. One of these landed close in on the port side of the vessel not far aft of amidships and the second close in on the port side of the stern.

The destroyer "Harding" was about two miles distant from the stern and directly in line with the longitudinal axis of the ship. The delayed action fuse of the second bomb must have worked admirably and have burst the bomb well down below the surface, for it lifted and dropped upon the ship an enormous quantity of water which from our point of observation completely hid the vessel from sight. As the finer mist disappeared we noticed that a perfect Niagara of solid water was pouring down from the bridge, the conning tower, the after turret and the quarterdeck. When this

(Continued on page 105)

Note how this bomb has thrown great masses of water across the decks of the "Frankfurt"

Dead Men's Fingers

One of the Most Interesting Groups of Our Less Common Fungous Growths

By Dr. William Alphonso Murrill, New York Botanical Garden

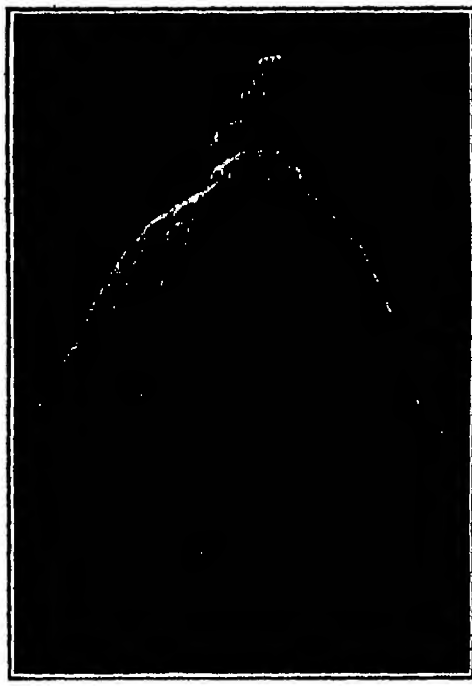
ONE of the summer boarders insisted that it was a dead rat another favored a leak in one of the sewer pipes as explanation The mycologist of the party investigated beneath the house and soon emerged triumphant bearing aloft a magnificent specimen of the veiled stinkhorn After he had explained how the green, slimy cap, borne on the white stem, was attractive to flies because of its odor, which developed only after the spores were mature and ready for distribution, all became interested, and it was one lady's opinion that the odor like that of the skunk, was "strong but not particularly disagreeable" From time immemorial, man has dreaded the unknown and greatly exaggerated what he has not understood!

The stinkhorns, or "dead men's fingers," as they are sometimes called, occur during the summer and fall about buildings, in cultivated grounds, or on the ground in woods, and most of them make their presence known by a powerful fetid odor The underground mycelium, or spawn, consists of cord like strands matted together, to which are attached rounded, pink or white "eggs," and from these arise at the proper season conspicuous stalks bearing at their apex the spores and the malodorous slime so attractive to blow flies, green flies, carrion beetles, etc

If one of these "eggs" is cut open, all the parts of the mature fruit body may be seen in embryo compactly tucked away in its various layers. Between the thin inner and outer coats is a thick gelatinous layer, which is traversed by a central column surrounded by a dark green substance If a fully grown 'egg' is kept warm and moist, it will soon develop, and the various stages may be watched The central column is composed at this early stage of cells closely compressed together, which absorb water and expand very rapidly, breaking through the roof of the 'egg' and leaving its 'shell' as a cup or volva, at the base of the elongated stalk

This expansion usually takes place at night and is so very rapid that the movement actually becomes visible The dark green mass, borne aloft on the stalk, melts to a slimy fluid containing minute, ellipsoidal spores, while a fetid odor is generated and borne on the breezes to all the flies in the neighborhood, advertising the fact that a banquet is prepared for them in exchange for their assistance in distributing the spores.

The stinkhorns, or phalloids, are remarkable for their peculiar and interesting forms, their attractive coloring, and their fugitive occurrence About one hundred species are recognized, widely distributed throughout temperate and tropical regions, but many are imperfectly known Of the commoner American species that are provided with conspicuous stalks and possess the well known disagreeable odor, perhaps the commonest is the veiled stinkhorn, or *Dictyophora duplicata*. The cap is bell shaped, 5 centimeters long, the surface appearing strongly reticulate-pitted after the fetid, olivaceous gleba has been devoured by flies or washed away by rains; apex truncate, perforate, spores oblong-ellipsoid involved in mucus at maturity, stem fusiform-cylindric, tapering at each end, cellular-spongy, white, hollow, 10-20 centimeters high, 2.5-3 centimeters thick, veil white, reticulate, variable in length, sometimes much expanded, always conspicuous, fragile, egg globose, nearly white, frequently pinkish, 5-7 centimeters in diameter



Left: A handsome specimen of Dictyophora indusiata, from Brazil, a species that displays a veil of unusual proportions. *Center:* Eggs of the ordinary veiled stinkhorn of the United States which when cut open show the mature fruit-body in perfect miniature. *Right:* The branched stinkhorn, Lysurus Borealis, of New York This is a comparatively recent member of the metropolitan flora having first been noted by the author in 1911

Some strange forms of the stinkhorn fungi

This very conspicuous and objectionable species occurs in the United States about buildings and near stumps in fields and in the edges of woods. It may be easily recognized by its conspicuous veil, which is attached near the apex beneath the cap and hangs down to the middle of the stem or lower There are few finer examples of natural lace-work than this delicate white veil The mature fruiting surface, or gleba, is extremely fetid, proving attractive to flies, which disseminate the spores The stinkhorns have usually been considered poisonous, although little experimenting has been done in the group on account of their odor According to McIlvaine, the eggs are tender and excellent for food when cut in slices and fried or stewed I have found the veiled stinkhorn frequently from midsummer to fall in New England and southward to North Carolina and Tennessee Fully grown eggs when brought into the house will usually develop mature plants in a single night

In the tropics, I have collected a species with a much larger veil called *Dictyophora indusiata*, which is one of the most remarkable and beautiful natural objects I have ever seen Specimens have been sent to me from Brazil, Colombia and the Philippines. This species is white, but there is another in the tropics and in the southern United States which is red all over and has no veil. In Hawaii the red species attack the roots of sugar-cane, causing an average loss of about ten per cent of the crop. Its development from the egg has been carefully traced, showing that in the later stages the stalk elongates as much as an inch and a half in a single minute!

In the sawdust stinkhorn *Dictyophora Ravenelii*, the cap is conic-bell-shaped, 2.5-3.5 centimeters long, the surface white and granulate or minutely wrinkled after the disappearance of the olivaceous gleba; apex smooth, white, umbilicate, closed by a thin membrane or at length perforate, spores oblong-ellipsoid, involved in mucus, stem cylindric, slender, tapering at each end, cellular-spongy, white, hollow, 10-12 centimeters high, 2 centimeters thick, veil membranous, usually scarcely half the length of the cap and concealed beneath it, very rarely protruding; egg ovoid, pinkish, 4-5 centimeters in diameter, containing the lower half of the veil attached about the base of the stem.

This species occurs in abundance in old sawdust piles and about rotting logs and stumps in woods and fields in the eastern United States and Canada. It may be readily distinguished from the veiled stinkhorn by the absence of a conspicuous reticulate veil, its cap is smooth instead of coarsely pitted; and its odor is less penetrating and disagreeable. The veil is a very thin, delicate membrane, which is usually concealed beneath the cap and therefore not noticed.

I have specimens from Canada and most of the eastern states and have found them at times in great abundance. One autumn at Ithaca I discovered a bed in an old sawdust pile from which I brought in eggs and mature plants by the basketful. At a certain stage of development we found it exceedingly difficult to obtain photographs that were not blurred by the movement of the stalks.

The common stinkhorn of Europe, *Ithyphallus impudicus*, looks very much like the sawdust stinkhorn, but has no veil of any kind and its cap is coarsely reticulate like that of the veiled stinkhorn. A pink variety is said to occur in the southern United States, but I have seen no typical specimens except in Europe, where it is fully as abundant and offensive as is our veiled stinkhorn in the eastern United States. A gentleman in France freed his grove of this species by removing the soil for a foot or more at every spot where the fungus occurred and filling the cavities with quick-lime. This method should be applicable about houses and on lawns for any species of the group. A destructive root rot of the grape is attributed to the common stinkhorn in some parts of Europe.

The elegant stinkhorn, *Mutinus elegans*, has a stem horn-shaped, cylindric, tapering gradually to the apex, pitted, hollow, white or pinkish below, bright-red or orange above, 10-17 centimeters long, about 2 centimeters thick, apex conic-acuminate, perforate, gleba greenish-brown, semi-fluid, fetid, smeared over the upper portion of the stem in an indefinite manner, spores oblong-ellipsoid, veil none, egg oblong-ovoid, pinkish, 2.5-3 centimeters long.

This species is very conspicuous by reason of its size and brilliant red or orange color Its odor is sickening and penetrating, but not so strong as that of the veiled stinkhorn. It occurs quite commonly in the United States in woods or in cultivated ground rich in decayed vegetable matter. I have specimens from most of the eastern states and have collected it at several places in New York, Pennsylvania, Virginia, and Tennessee, usually in woods or near trees. At Ohio Pyle, Pennsylvania, I found it abundant about an old stump beneath a porch, where the fruit-bodies appeared daily for some time. Excellent specimens were also obtained from a tub in one of the greenhouses at the New York Botanical Garden. The eggs are curious objects, especially in section. According to McIlvaine, they are edible when sliced and fried.

Another American species, *Mutinus Ravenelii*, is

(Continued on page 107)

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Two views of a travelling and floating store which stops at various towns and villages along the St Lawrence River

Moving Houses to Clear the Mines

HIBBING, Minnesota, called "the richest village in the world," is going through a novel experience. A part of this prosperous town in the iron range is being moved Hibbing is one of the new towns which have sprung up since ore was discovered, and it is really a sort of "industrial romance" made practical It is not literally a fact that the whole of Hibbing is being moved, but people talk that way Sixteen blocks of the original part of Hibbing, overlay a valuable "40" of land which it is desired to exploit, and as this town has never failed to grasp opportunities, this one-third of the village is being cleared of buildings so that mining companies can have access to the valuable deposits. In place of this cleared away section, a new part of the village will be reared on the outskirts.

Because of the number and the size of some of the buildings to be moved, this activity has called for the highest skill on the part of the home movers. Steam locomotive tractors, equipped with traction belts, have been largely used, together with the usual jacks and heavy trucks, logs, etc, as shown in our cover illustration.

It is almost impossible to estimate the many millions which will be needed to tear down and rebuild such a large area, but Hibbing feels it is making history, and so all classes of labor, the mining companies and citizens, are working side by side to accomplish results. It seems an almost superhuman achievement, but in the end another city will rise as the result of a new kind of town building and the exercise of a community spirit which is working for the good of all In a short time there will be one continuous Hibbing entirely different from the original village, but a witness of the heroic work done in the iron ranges.

As a matter of fact, the ranges, on one of which Hibbing is located, furnish three-fifths of the millions of tons of ore which the United States contributes to the world. All this is a part of the development of the past fifty years, and the army of employees necessary to work this ore is a vast one It is estimated there are 125,000 men working on these ranges in Minnesota alone, and the industry creates a certain atmosphere, and makes town, railroads and immense lake traffic

The number and nationalities of foreigners employed is a revelation to one who visits the ranges for the first time Perhaps no activity in this country can furnish such a diversity of nationalities Canadians, English, Scotch, Hollanders, Bulgarians, Montenegrins, French, Norwegians, Belgians, Germans, Swiss, Finns, Russians, Swedes, Danes and others are found in various occupations. Many have gone directly to the mines on landing in this country Others have lived in the United States for a number of years. Skilled and unskilled, they are important factors in the development of the range. First came the Scandinavians, Finns and Austrians to help dig Lake Superior ore, and following some time later were the races of Southern Europe—from Serbia, Montenegro, Bulgaria and Croatia

These workers are young or middle aged, and their children attend schools which are up-to-date and of a standing far ahead of those of the countries from whence these people came Hibbing recently erected a grade building at an expense of one hundred and twenty five thousand dollars. The range towns are interested in all outside matters. They have a free, generous spirit—a sort of "spirit of the range," which comes from familiarity with colossal movements that are taking place daily Great ore pits, heavy cars loaded with rapidity and speed, the latest improvements in machinery—these are features of this stupendous business Nowhere else in the world is it possible to uncover a bed of ore which stretches for mile after mile, and to mine it in places as if it were sand by means of steam shovels, locomotives and trains of cars.

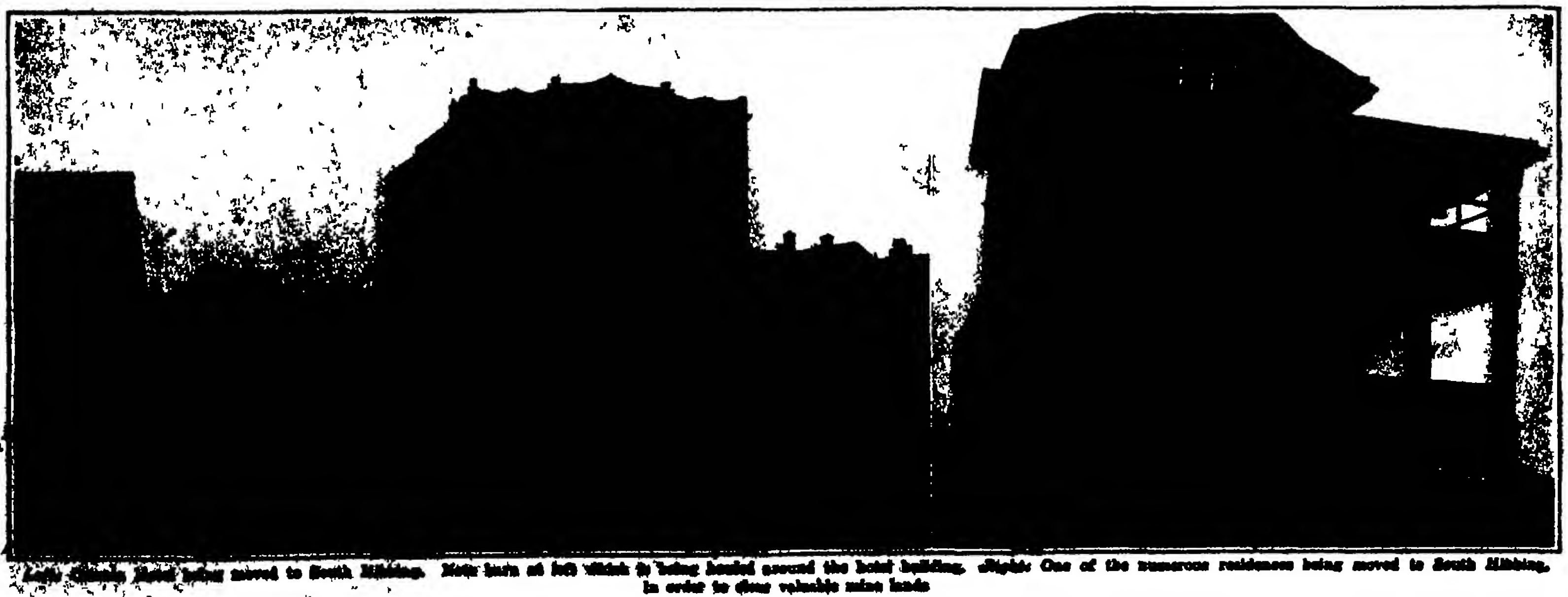
An interesting feature in connection with the ore mines of Minnesota is that many of them are owned by the State In fact, every year the permanent school, university and trust funds receive from this source by way of royalties about seven million dollars

Business As Usual Aboard Ship

WHITHER it is to escape high rents and high taxes, or to be able to shift one's location at will, the fact remains that business has followed in those footsteps of many families which lead to the houseboat. In many different parts of the country we find all kinds of business being done aboard ship and apparently with excellent results.

In the heart of New York City, for instance, there are some nine houseboats one and two stories in height, moored to a dock in the shadow of one of the huge East River bridges. These houseboats serve as the quarters for as many fish and seafood dealers, whose wares come direct to their backdoor when the fishermen pull up every day In the outskirts of New York City there is a hardware and ship chandler establishment which thrives far out in the bay, aboard a houseboat There are many refreshment stands and other similar establishments which find it the part of good business to operate aboard ship rather than on good old *terra firma*.

Most unique, perhaps, is the travelling store idea, of which the accompanying illustrations convey an excellent pictorial description This particular establishment has travelled over the St Lawrence River for several years, and it is said that wherever it stops, the trade is sure to be flourishing Not only do the inhabitants of the towns and villages find rare bargains among the offerings of this travelling store, but they also take this opportunity of stocking up on numerous articles of food, wearing apparel, household utensils, and so on The line of goods carried in this floating store ranges from a feather for Milady's hat, to canned cherries for dessert, most of the stock having been bought at auction or at receiver's sales in order to reduce the selling prices Residents of the rural districts of the east whose memories extend back will recall the peripatetic peddler who came through the country side at intervals with his miniature department store on his horse-drawn cart. Where water transportation is good, why not have the water borne peddler?



Left: [illegible] Hotel being moved to South Hibbing. Note barn at left which is being hauled around the hotel building. Right: One of the numerous residences being moved to South Hibbing, in order to clear valuable mine lands

Two views which, in conjunction with the cover illustration, furnish an excellent idea of Hibbing's house-moving activities

Where Oil Occurs

A Brief Description of the Rocks and Sands in Which Petroleum Is Found

By C. H. Messerly

It is approximately true that any hole in the ground, anywhere, will yield water if we drill it deep enough. That the corresponding proposition for petroleum is not true every layman must understand, and if he did not the general knowledge of wildcatting and its huge losses would make him realize the facts. It is doubtful, however, whether the layman understands why this should be so, or has any very clear conception of the geological status of oil. How does it occur, and where, and why? These are questions of much interest, and it is in the attempt to answer them that Mr Messerly writes the present article.—THE EDITOR.

EXPERIENCE has taught us that oil does exist, and that it is found in formations or reservoir rocks known as sand, sandstone limestone etc, and that commercial deposits generally occur in the higher parts of folds of the earth's surface, called anticlines, domes, monoclines, etc. Water is generally found in the same stratum as the oil, but in the lower part of the fold. Oil being lighter, is found next above, and gas, being still lighter, in the top. Some authorities say that oil is generated in underlying strata and has migrated through the different formations and crevices to these reservoirs, which are capped or covered by practically impervious beds of shale, sandstone or limestone, most frequently shale. The action of this cap rock is to prevent the oil from leaking away to the surface and disappearing. This is what must have happened in some fields from which the oil has vanished.

One of the most widespread formations overlying gas and oil sands is the Utica shale above the Trenton limestone in the Ohio and Indiana fields. The Clinton sand of central Ohio is overlaid by the Clinton shale. The oil sands of Pennsylvania and West Virginia are all overlaid by impervious shales. In Louisiana fields a hard stratum of limestone sometimes acts as a cap rock overlying a more pervious portion of the same formation.

The porosity or capability of sandstone and sands to hold oil is due to the shape and arrangement of the grains. In the case of sandstones, the occurrence of oil is due not only to structure, but is affected also by the continuity of the stratum. Drillers recognize the internal variations when they speak of a sand being open or close, soft or hard and good or poor in character. The question of the amount of oil which a certain formation can contain in view of its porosity is a rather complicated subject. The texture of the sand is of supreme importance. Sandstones and shales often carry oil, but they are not the most favorable reservoirs, since in most sand stones the cementing material binding the sand grains together fills the pores so that the rock can hold only a small quantity of fluid.

The percentage of voids in the various kinds of strata varies considerably. Sands may contain from 15 to 35 per cent voids, sandstones 5 to 15 per cent, conglomerates as high as 30 per cent, shales from 2 to 10 per cent, and some dolomitic limestones are reported to contain as high as 35 per cent. The percentages are so variable that one cannot take the material in one field to be a criterion or measure of material in other fields.

The quantity of oil in sands depends on the percentage of voids in the sand and its saturation, by which is meant the percentage of oil present by volume in a cubic foot of sand. We are told that some sands contain 20 per cent voids, and if those voids were full, the saturation would be 20 per cent, hence 100 cubic feet of sand would contain 20 cubic feet of oil. The United States Government, in its estimates of oil reserves, takes 10 per cent as the saturation. For example A bed 100 feet thick and covering an acre of land would contain (42 gallons per barrel—7.5 gallons per cubic foot) 77,786 barrels. It is estimated that the porosity of the Appalachian field is 12.5 per cent, of the Illinois and Mid-Continent field 17.5 per cent, and of the California field 25 per cent.

It is a well-known fact that the quality of crude petroleum is determined by the impurities contained therein. As an illustration it may be cited that Lima, Ohio, oil contains about 75 per cent sulfur and that Pennsylvania oil contains only about 08 per cent. Because of these impurities and the greater cost of refining the price also varies.

I cannot find any scientific theory for the fact that more impurities are contained in the oils of some fields than in others, but it is possible these may have been picked up in its migratory process, rather than from the sand where the oil happens to be found.

The specific gravities of petroleum have also been used as rough measurements of its value. The lighter the oil, the better it is generally considered. An oil with a specific gravity of 40 degrees will generally produce more of the valuable by products than one of 15 degrees.

One author says the difference in specific gravity is due to migration, or travel from one formation to another. Another that it is due to age, the heavier oils occurring in formations that are much younger than those containing lighter oils, although it is stated there are exceptions to this rule.

In conclusion, or as your parson would say, "Lastly," it might be of interest to group the oil pools of the United States into fields. The most important of these are the Appalachian, Lima-Indiana, Illinois, Mid-Continent, Gulf Coast, California, Colorado and Wyoming.

The Appalachian field covers a very large area, but it is no longer the most important in quantity of production, although it continues to hold first place in quality. It embraces all oil pools east of central Ohio, including New York, Pennsylvania, West Virginia, southeastern Ohio, Kentucky and Tennessee. With the exception of that from Kentucky and Tennessee most of this oil is considered Pennsylvania grade, free from objectionable sulfur and from asphalt, and rich in paraffin.

The Lima Indiana field comprises Western Ohio and Indiana. The petroleum in this field was found in the Trenton limestone, contains little asphalt but is contaminated with the objectionable sulfur compounds.

The Illinois field is located in the state bearing its name, the main portion of which is associated with a structural feature known as the La Salle anticline, extending from the northeastern part of the state into southwestern Indiana. The petroleum is thick, asphaltic, and contains sulfur in the northern portion, but in the southern part of the field it is found at a greater depth, is thinner and contains little or no sulfur. The Mid Continent field includes the oil pools of Kansas, Oklahoma, Caddo, De Soto, Louisiana, and northern Texas. The petroleums of this field vary in composition within wide limits. Most of the Kansas oils are asphaltic, but in Oklahoma petroleum of both paraffin and asphalt base are found. The crude petroleum of the Healdton field in Oklahoma is of lower grade than the crude oils from the Glenn pool and Cushing field on account of the lower gasoline content and the large percentage of sulfur present. In northern Louisiana and Texas paraffin base petroleums, free from sulfur, predominate, but asphaltic oils of higher gravity have also been found.

In the Gulf Coast are included a number of areas lying in the coastal plain region, the pools of southern Texas and southern Louisiana. The oils have been found in association with salt domes, which also carry limestone and gypsum. They are usually heavy, asphaltic and sulfurous, but occasionally lighter, non-asphaltic ones also occur.

In the California field the petroleums have been usually characterized by much asphalt, although in recent years lighter oils have been found.

In the Colorado field a high grade, light illuminating oil is found in Boulder County, a lubricating oil in Routt County, etc.

The Wyoming field is one of the newest, the oil in Big Horn County being a heavy, black asphaltum oil. In other places oil of a paraffin base and higher gravity has been found.

Although new producing formations are constantly being developed, in almost every oil field of any size or age there has been found one or more sand strata that stand out prominently because of the thickness of their "pay streaks" and producing qualities; these strata are used for purposes of comparison, values being frequently based upon their past history and production per acre over a given period of time. In the eastern oil fields we find the second and third sands of Oil Creek, Pennsylvania; the second, Tiona and Bradford sands of northwestern Pennsylvania; the Wangle & Porter and Richburg sands of western New York; the 100-Foot, third and fourth sands of Butler County, Pennsylvania, the Salt sand, Maxon, Big Injun, Gordon and fifth sands in West Virginia; and the Cow Run, Berea, Clinton and Trenton sands of Ohio. In Illinois the Casey, Robinson, Bridgeport, Kirkwood and McClokey are well known; and in Oklahoma there are a number of different producing sands, the Bartlesville being the most extensive. In the Gulf Coast, Louisiana and Texas fields, the sands occur more in irregular lenses and the production is in pools.

Reducing Noise in Factories

MANY authorities believe that loud and continuous noises exert a baneful effect upon the nervous system, and are responsible for much of the nervous disturbance and maladies of the nerves, which are, apparently, on the increase among dwellers in the cities. Even when the victim is so habituated to the noise which surrounds him as to be hardly conscious of it the noise may, nevertheless, exert a deleterious effect. In a recent number of a German technical magazine, an engineer named Walter Ritter, has suggested certain methods for reducing the inescapable noise in factories, machine works, mines, etc., to the lowest possible minimum. His basic idea is that it is less important to reduce the actual noise than to check the spread of the vibration to which the noise is due, since in his opinion it is such vibrations that chiefly affect the nerves, having a more injurious effect than the pounding of a steam hammer or the buzzing of a motor.

The first law he lays down is that the foundation upon which a piece of machinery is erected must be absolutely solid and resistant to pressure, and he suggests that a suitable material for making such foundations is armored cement or else a masonry of slag set in mortar of pure cement. However, this foundation does not lessen the noise, since each of the two materials suggested is an excellent conductor of sound. One or the other of these materials is essential because of the firmness and solidity, but Mr Ritter suggests the mixing of the cement with quartz sand and finally broken stones to form a sheet 10 centimeters in thickness as the first layer of the foundation. Upon this are placed successive layers having a slightly different composition, gray lime and kieselguhr, each layer being firmly connected with the one below. The uppermost layer which should be from 10 to 20 centimeters thick should consist of kieselguhr cement. A foundation built in this manner possesses the property of deadening sound considerably and also reduces the vibration since the use of the kieselguhr has the effect of imparting elasticity to the cement.

Vibration is further reduced by means of an insulating material. Rubber might be considered best for this purpose, but rubber does not assist in lessening the noise. The best material for laying under the machine has been found by experiment to be a thick wool felt, the so-called iron felt with an impregnated surface or crust. Such felt exhibits great resistance to pressure combined with a high degree of elasticity. It has been shown by experiment that this felt is not "deformed" by loads up to a pressure of 1450 atmospheres. Such favorable results have been obtained by this method of constructing machine foundations that it is to be expected their use will be rapidly extended.

Electronic Classification of the Elements

DAUVILLIER, in *Revue Générale de l'Électricité*, lays stress on the recent advances in this subject, due chiefly to the use of X-rays, [illegible] reference to the formula published by [illegible] the subsequent classification is [illegible] irrespective of atomic weight [illegible] the electronic structure [illegible] and published [illegible] are [illegible] eight vertical columns, [illegible] and eleven horizontal columns [illegible] of layers of electrons.

The Red Sea Dollar

How a Trade Coin of More Than a Century's Standing Is Being Retired

By Frank Parker Stockbridge

RECENT reports from Arabia and the African coast of the Red Sea point to the success of the interesting effort of the Italian Government to substitute an Italian coin for the Austrian Maria Theresa dollar, which for more than a century has been the standard unit of value and medium of exchange in the entire Red Sea District.

An Italian decree of May 31, 1918, provided for the coinage at the royal mint of a silver trade dollar to be known as "The Dollar of Italy" Primarily intended to be used in the Italian colony of Eritrea, the expectation that it would eventually displace the Maria Theresa dollar throughout the Red Sea commercial district seems about to be fully realized. The first million of the new dollars were readily accepted by the natives of Eritrea on a parity with the Austrian coin with which they had been so long familiar, and they were found to pass readily across the borders of the colony on the same basis in dealing with the other countries and colonies adjacent.

The Red Sea commercial district includes Eritrea, Abyssinia, Somaliland (French, British and Italian), Makalla, the Aden Protectorate and the Arabian provinces of Yemen, Asir and Hedjaz, now erected by the terms of the Treaty of Versailles into the independent Kingdom of the Hedjaz. Throughout this district the Maria Theresa dollar has circulated for much more than a hundred years. The coin was first minted in 1780 at Trieste, and up to 1914 large numbers were minted annually, all, curiously, bearing the original date, 1780, there being no apparent necessity for changing the original dies. The best obtainable estimates at the beginning of the war were that more than 200,000,000 of these trade dollars were in circulation or hoarded in the Red Sea district.

The rise in the price of silver during the war resulted in the buying up of many of these dollars by traders, for export as bullion, and Mr Addison E Southard, United States Consul at Aden, from whom many of the facts here set down were obtained, places the proportion of Maria Theresa dollars thus withdrawn from circulation at more than one-third of the total number

With no new supplies available, and the natives uneducated in the values of any other form of coinage and totally ignorant of the use of paper money or of checks and drafts, there resulted a serious shortage in the medium of exchange for commercial purposes and traders found themselves, in the late years of the war and the period immediately following, reduced to actual barter in order to obtain the coffee, skins, hides and other products of the region. The actual cotton piece goods or other manufactured commodities had to be shown and exchanged on the spot, in many instances, to induce the natives to part with their wares.

The new Italian dollar was designed not only to supply this lack for the colony of Eritrea, but to extend Italian political and economic influence throughout the Red Sea district, and this result seems to be well under way toward accomplishment. The Maria Theresa dollar was coined in Trieste for private demands and a mint charge of 1½ per cent. collected It was solely a trade dollar and was not issued for Government use The new Italian trade dollar is coined in Rome for the Eritrean government but will also be coined upon private demand, as it is not intended to displace the Italian currency which is the legal circulating medium in Eritrea, but solely to be used as a trade dollar

On the new coin the effigy of symbolic Italy, much resembling that of Maria Theresa on the old Austrian coin, is the principal device The Maria Theresa dollar has a brooch of ten jewels on the shoulder of the robe, by examining these jewels to see whether or not they were worn smooth the native trader estimated the possible loss of weight in the coin in hand This brooch is omitted in the new Italian piece The double-headed Austrian eagle on the reverse gives place to the single-headed Italian or Savoyard eagle, while the Cross of Savoy is emblazoned on the shield carried on the eagle's breast, in the same fashion as the arms of Austria are carried on the Maria Theresa dollar

At first there was some objection on the part of the Mohammedan natives to the presence of the cross on the new coin, and the keen-eyed Arabs were quick to note the absence of the shoulder brooch. The difference in the inscriptions is of no significance, as the natives cannot read them in any language On the whole, the design has proved attractive.

The new dollar is almost identical in weight and size with the old one The Austrian dollar weighs 433.02 grains and is of silver of a fineness of .8333, the Italian dollar weighs 433.12 grains and is .835 fine. Each has a diameter of 40 mm., or 1.57 inch

Offered in the Eritrean market at the price of 9 Italian lire, the new dollar was rapidly absorbed, although a premium of half a lira was offered by some traders for use in Abyssinia "The Abyssinian," writes Consul Southard, is a particularly conservative individual and it will probably be some time before he will accept the new dollar as the equivalent of the Maria Theresa dollar even though it weighs slightly more"

The establishment of the Italian trade dollar in Abyssinia will work decidedly in favor of the development of Italo Abyssinian trade relations The whole effort to substitute a new trade dollar for the old inaugurates an interesting contest between commercial progress and the intense conservatism of the Red Sea native producer If the district can absorb, as is anticipated some 2,000,000 of the new dollars annually traders of all nations will find it much easier to do business than it has been since the coinage of the Maria Theresa dollars ceased, nearly seven years ago

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

"The President's Great Opportunity"

To the Editor of the SCIENTIFIC AMERICAN

I note on your editorial page of the SCIENTIFIC AMERICAN bearing date of July 16th, an article entitled "The President's Great Opportunity"

I wish to express my most hearty approval of the stand which you have taken on the question of disarmament and the futility of war

I have read the SCIENTIFIC AMERICAN for many years, and it has devoted much space to the description of the United States naval vessels of various types. I never could interest myself in these great machines, because they were designed either for the purpose of actually destroying human life and human property, or as a menace to the other nations of the world.

For the last century we have prided ourselves on the beneficent contributions of science, discovery, and invention to the well-being of the human race. The modern practice among the great nations of the world of turning these great forces into destructive agencies of war involves a contradiction which is so senseless and so absurd that one wonders sometimes whether the reason of man has been dethroned and replaced by the savage instincts of primitive man.

Your attitude is so reasonable, and the stand you have taken on this question is so firm that I am sure it will result in great benefit. It is unusual for the editor of a scientific journal to take such a stand, but it is [illegible] fitting that he should do so; first, because [illegible] of settling difficulties is not [illegible] but preposterous; second, because a [illegible] such a high source carries with it a [illegible] Whether the results of the past [illegible] of future wars will bear a scien[illegible] stand you have taken is not only [illegible] layman's point of view, but also [illegible]

[illegible] to commend most highly the [illegible] taken in this matter.

ELWOOD HAYNES.

[illegible]

Make Air-Stunting a Criminal Offense

To the Editor of the SCIENTIFIC AMERICAN

As a former pilot in the Air Service, may I compliment you on your editorial, "Aviation Fatalities," in your July 23rd number I agree most heartily that there is no place for stunt flying in commercial aviation

It seems to me that any pilot who engages in stunt flying or any other needlessly dangerous maneuvers except in connection with military aeronautics is guilty of sheer criminal negligence It would be a great help to the cause of commercial aviation if legislation could be enacted to provide adequate punishment for such practices.

Very few pilots who have kept up their flying have died of old age I believe such editorials as yours are helpful in forming a public opinion which will insist on pilots exhibiting at least enough self-control to refrain from practices which jeopardize not only human lives but the development of a vital industry

Philadelphia, Pa EDWARD M POWELL

The Bird-Cage Problem

To the Editor of the SCIENTIFIC AMERICAN

The following is an attempt to answer A. B C.'s question, which appeared in the correspondence column of the SCIENTIFIC AMERICAN for June 11, and reads as follows "A bird sitting on a perch in a cage is weighed together with the cage. How does this total weight compare with the weight of the same cage but with the bird flying in it? Why?"

Such a question tends to test the reasoning power of a student of science, inasmuch as he is called upon to apply the scientific principles that he has so studiously acquired A law of science is often called upon to solve many a unique problem, but quite often its application is only perceived after minute observation.

In this case, I believe that the problem can be most clearly stated in a concrete form, which for simplicity may be as follows: A cage is placed upon the pan of a spring scale or balance. The indicated weight of the cage complete with its perch, we will assume to be four pounds. If we then place a canary, weighing, say, three and one-half ounces, on the perch in the cage, the dial hand will show that the total weight is four pounds, three and one-half ounces. This is of course obvious, because the bird is suspended by the perch, which is in turn suspended by the cage Now, then, let the bird take to flight, and immediately the dial hand returns to four pounds, showing a loss which is exactly equivalent to the weight of the canary i.e., three and a half ounces

You ask why this is so?

What has become of the weight of the bird? It is against the laws of the conservation of matter and energy to suppose that the bird has lost his weight, and therefore weighs nothing Yet the dial hand would have us believe so The duty of upholding the canary has been transferred from the perch to the surrounding atmosphere, and this reaction of the atmosphere against the muscular force of the canary extends *beyond* the cage But on the other hand if the air were a component part of the cage (such as would be ideally represented by one made of glass and air tight, of course having air confined in it for the bird's sake) then the dial hand would indicate the same weight whether the bird was flying or at rest on the perch In flying in such a closed system, the reaction of the air to the muscular power of the bird does *not* extend beyond the cage

Such a closed system forms a gravitational unit, and containing as it does a certain definite amount of matter subject to the action of the earth's gravity, no change of position of its integral parts can be expected to change this mass.

In summing up, the flying bird cannot be weighed directly unless the air in which it flies is confined within the boundaries of the cage If on the other hand the air is not confined, the flying bird registers no weight

I believe I have made myself clear in this explanation GEORGE H LAKE.

Cleveland, Ohio.

Buoy or Buffer?

To the Editor of the SCIENTIFIC AMERICAN

Re your last issue (July 3), 'Is Sauce for the Goose Also Sauce for the Gander?" I note Mr C E. Randall's sarcastic letter which is worth printing since it is at the expense of some newspaper But what of the SCIENTIFIC AMERICAN, which describes an old automobile tire applied to a mooring buoy in these words, "to keep it afloat, thereby replacing the cork filling," etc.

The photograph shows a hollow sheet metal buoy in which air is employed "to keep it afloat" and the only office of the tire is evidently to prevent injury to the hull of the small boat (or flying boat) when "picking up" the buoy E. PAUL DU PONT

Montchanin, Del.

The Last Word In Power Houses

Some of the Remarkable Features of the New Delaware Station That Typify Present-Day Practice

By William A. McGarry

General view of the Delaware Station of the Philadelphia Electric Company, showing coal storage basin, coal tower, and conveyor

ELECTRICITY is so well known as a labor saver that most consumers and even many of the big producing companies take it rather as a matter of course. It might also be said that progress in the science of producing electrical energy has been so rapid that advertising has found difficulty in keeping pace. For that reason the illustration used by the Philadelphia Electric Company in introducing to the public its new Delaware Station, held to be the world's most modern power house, is of more than ordinary interest. In announcing that the first thirty thousand kilowatt turbo-generator in the station had been placed in operation, the company pointed out that this one machine will do the work of a million and a quarter men based on a twenty-four hour day.

In size and total power output there is nothing particularly new to modern engineering practice in this plant. *Its second unit started operation December 31, 1920,* and eventually there will be six generators of thirty thousand kilowatts each, each operated by four steam boilers. But in methods of construction, material used and electrical equipment the plant marks distinct developments of almost incalculable value, chief among which from the viewpoint of the power company man is the pipe room devised by the Engineering Department of the company.

Construction features of the building are unique. They are of interest not only from the engineering point of view, but also in a popular way as demonstrating the ingenuity of modern technical skill in overcoming obstacles even when faced with the lack of material that has been considered essential. Work on this plant was started just about the time the United States got into the World War. Before anything but preliminary excavation had been done it became apparent that it would be impossible to obtain the structural steel in time, because of the demand of the ship yards and munitions plants. A building constructed entirely of reinforced concrete had not even been considered, particularly after soundings which showed that bed rock was from twenty to forty-eight feet from the surface.

The site of the plant is the old Neafie and Levy Shipyard on the banks of the Delaware River, on a plot between Penn Treaty Park and a section of the William Cramp and Sons Ship and Engine Building Company. Concrete is not used exclusively in electric power plant buildings, as a rule, because of the tremendous loads to be carried, particularly in the boiler rooms. The special ground conditions here made it seem more impracticable than ever. But when the engineers were convinced that it would be impossible to get the steel during the war, and that without some substitute the work must be abandoned for some years, they began to consider what might be done.

Old designs for the plant were discarded and an entirely new set of plans were drawn. This called for reinforced concrete construction throughout save for the use of I beams from which to suspend the boilers. Later in the work steel was obtained for the roof trusses and conveyor bridge. It has been the practice in such plants to carry in bunker storage from five to six thousand tons of coal. If the old plan of weight distribution had been followed it would have been necessary to construct the supporting columns and foundations so large as almost to eliminate the limited aisle space in the boiler rooms and elsewhere. In general terms it might be said that the main problem of the new design was the elimination of weight. This was achieved primarily in the coal bunkers.

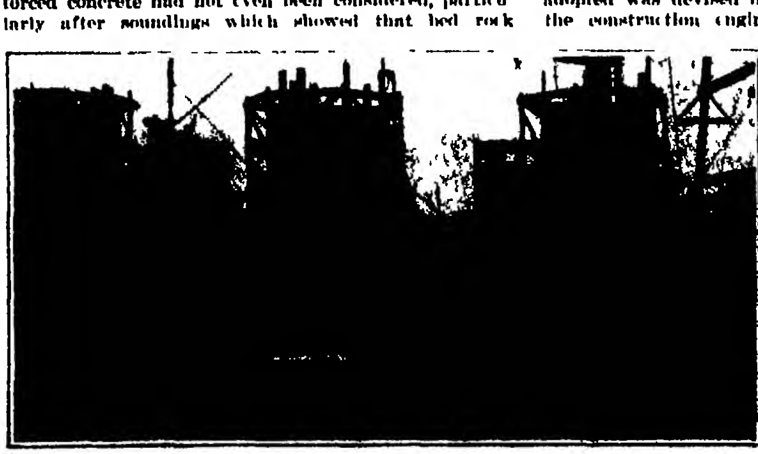
Provision was made here for the storage of but one thousand tons of coal, instead of five or six, the location making it possible to provide for ample storage up to twelve thousand tons on barges in a basin between the bulkhead and pier head lines. This storage is essential to assure continuous service. Various other minor economies of weight were made wherever possible.

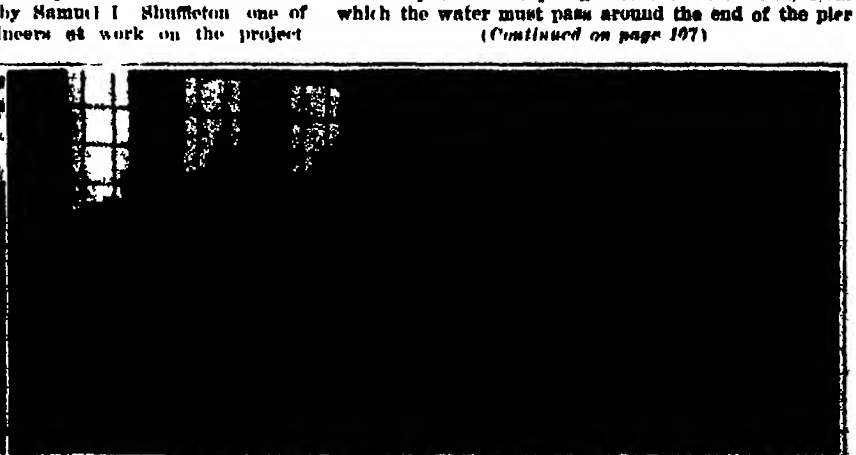
Several expensive and tedious methods were available for sinking the foundation pits to bed rock. The one adopted was devised by Samuel I. Shuffleton, one of the construction engineers at work on the project. In the center of spots marked for columns, ranging in diameter from ten to fourteen feet, he drove a heavy pile which was used as a base for a mast. On this was mounted a trip hammer on a revolving carriage. Sheet steel, interlocking piling was then driven into the earth on the outer line of the foundation column, the hammer revolving and striking each sheet in turn until bed rock had been reached. By this method the piling was driven through boulders, ancient wooden piles and all manner of obstructions.

When the entire circle of steel piling rested on bed rock the mast was removed and the earth and mud within were siphoned out. Bed rock was cleared by pounding with a section of steel rail. A steel cylinder, flared at both ends, was then lowered into the pit. Concrete poured into it settled on bed rock and as the pit filled, the cylinder was drawn up, until all the water had been replaced by concrete. By this method pressure on the steel piling was maintained virtually uniform within and without during all the stages of the excavation. Thus foundations were placed.

There are four boilers to each turbo-generator, so that the total in the completed plant will be twenty four, of which eight are now in place. Water is supplied to the condensers through six by ten foot tunnels from the river. Since such tremendous quantities will be used for the completed plant, it was necessary to provide special cooling arrangements. Discharge tunnels empty into the river directly under the coal tower pier, which projects from the bulkhead line at the center of the company's property to the pierhead line in the river. The intake is from the east basin. Steel sheet piling was placed on the east line of the coal pier and extending some distance from the mouth of the discharge tunnels. As the relatively warm condensing water is discharged it strikes the supporting piles of the pier and is broken into many streams. These in turn are deflected by the sheet piling into the west basin, from which the water must pass around the end of the pier

(Continued on page 107)





Left: Five of the caissons for the foundations of the Delaware Station. Note the retaining wall of sheet steel piling back of the railroad tracks which [illegible] as shown in the foreground. *Right:* View of turbine hall in the Delaware Station, with one of the huge generating units and condenser in the [illegible]

Before and after phases of the Delaware Station: Excavating for the foundation and the finished turbine hall

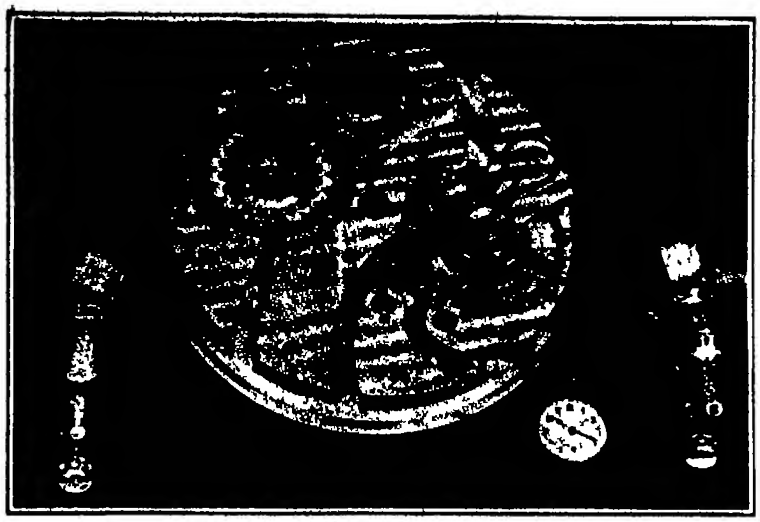
The World's Largest Watch

HISTORY records the making of some huge timepieces, like the turret clocks of old with hands two feet long with a bell which could be heard twenty miles away But it remained for the experts of our own day and generation to produce the biggest watch known to the science of horology.

It is true that watches were, in the beginning, very large on account of their striking part, when the case was pierced to let out the sound of the bell, yet these huge watches were mere pigmies compared with the giant timekeeper recently exhibited at the National Museum in Washington Great crowds flocked to see the details of construction and observe the mechanical action of the object which is the guardian of man's habits and the critic of his wasted moments.

The big fellow is 9½ inches in diameter and 1½ inches thick, or six times as large as the standard watch It is said that the average time required to build a good watch is nine months, and that it often takes a full year If this be so, one can be led to fanciful speculation as to how long it took to make the various parts of the mammoth watch and to assemble and test them, for this interesting specimen is complete and perfect in every detail. Pivots, staffs, balance, hair spring—everything, in fact, is exactly like the watch which you carry around in your vest pocket, even to the twenty three jewels (synthetic, of course) specially cut and designed The train, which, technically, is the series of wheels carrying the motive power from the barrel through the balance and escapement, is of gold, the cogs and teeth of the train wheel having been treated in a particular manner to harden them for wear The winding-wheel and other parts are of steel There is but one difference between this ace of the industry and the watch of normal size, and that is in the motive power It has a mainspring which measures nine feet from tip to tip but which is hardly strong enough to move the train The masters of the art, who built this thing of scientific perfection, knew that the finely-tempered steel might snap, so they ingeniously devised a weight to keep the works in motion. By way of interest there are presented herewith a number of photographs of standard watch parts, greatly magnified, so as to give some idea of the delicate nature of such mechanisms.

Would that the students of the dead [illegible] could see this horologe! The [illegible] of St. Paul's, Westminster and the [illegible] seem like crude affairs when [illegible] with this mechanical marvel of [illegible] day. Built at a cost of $5000, and [illegible] the standpoints of finish and excellence of handiwork comparable to its little brothers, the monster watch will be famed as a national [illegible] as well as a curiosity for a long time to come.



This huge watch measures 9½ inches in diameter and 1½ inches thick. It cost $5,000 to construct, and has been placed in the National Museum

Past and Present of American Railroading

PRIOR to sending the famous De Witt Clinton steam locomotive to Chicago to participate in the Pageant of Progress that is to be held in that city, the old locomotive and its train of coaches were tested over the New York Central tracks in New York City and vicinity The DeWitt Clinton locomotive it will be recalled, was the first steam rolling stock of the Mohawk & Hudson Railroad—the original unit of the New York Central Lines. It made its first trip over the road from Albany to Schenectady on August 9, 1831

Standing on a track alongside one of the huge Pacific type steam locomotives of today, the little DeWitt Clinton locomotive presents an interesting contrast in railroading It measures 12 feet 10 inches long and 8 feet 5 inches high. It weighs 12,098 pounds. The modern locomotive alongside, which hauls one of the through fliers, weighs about 17 times the weight of the entire DeWitt Clinton train The old locomotive is fired with wood and in a recent test it developed a speed of 15 miles per hour when pushed to the utmost

The old and the new in American railroading: DeWitt Clinton train of 1831 alongside a modern passenger train

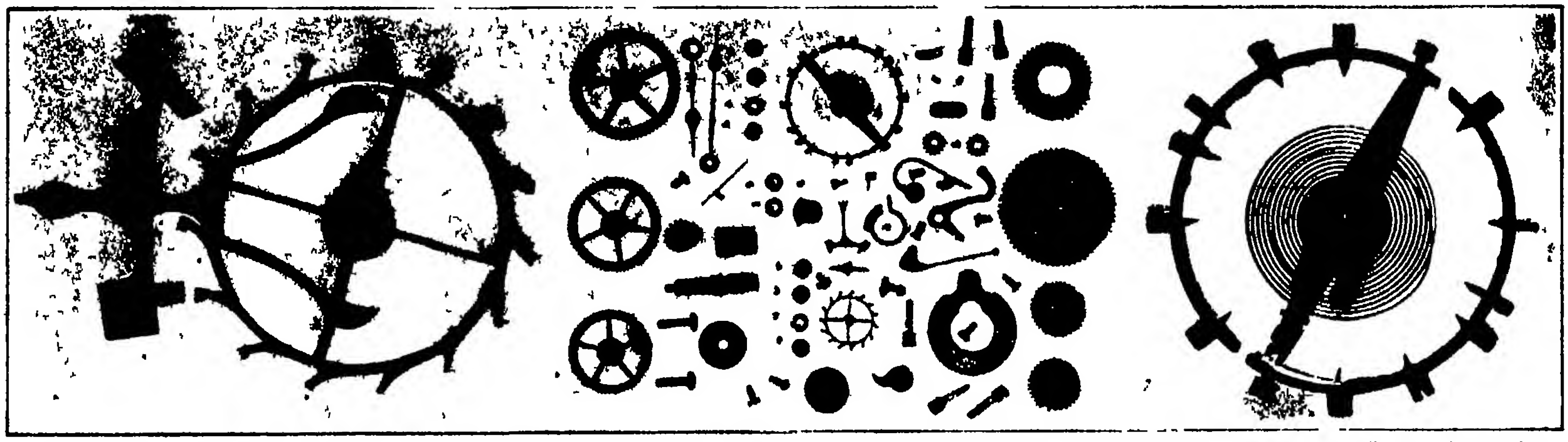
Electric Resistance of Human Body

MEASUREMENTS as to the electric resistance of the human body without including the opposition through the skin where the current entered and departed from the body for the first time, have been made by F Wenner of the National Bureau of Standards. The conclusions are at variance with those previously announced by M Gildemeister, a German scientist whose methods of measurement were dissimilar The elimination of the substantial and uncertain resistances through the skin is responsible for more representative determinations than heretofore attained

Interesting is the deduction that the same portion of the body of different individuals may vary in the degree of electric resistance by a ratio of three to two or even more Also, the opposition of the individual varies from day to day and frequently by slight degrees within the hour The position of the body and the extent to which the muscles are relaxed are likewise influential factors contributing to variations in resistances The pathologist is invited to study these differences inasmuch as some of the changes are due to the conditions of the body as it pertains to the science of diseases

The experiments were conducted in a laboratory of the Bureau of Standards, the feet of the person submitting himself to the test being soused in a bath and the hands also placed in salt water, being immersed slightly above the wrist An alternating current of a few milliamperes was passed from hand to foot, and the potential drop caused by this current between the other hand and other foot was measured by an alternating current potentiometer The ratio of this difference in potential was considered as the resistance The trunk of the body was found to have a resistance varying for different individuals, but on the average it is about 25 ohms

For the frequencies used, 25, 60, and 100, the resistance was found to be independent both of the frequency and of the current. Inasmuch as a current of 1 ampere through a vital portion of the body may cause death, the scientist considers it of interest to know that this corresponds to a potential drop of only a few volts in a vital part of our body



Left: Escapement parts of 16 size 17-jewel watch considerably magnified The escape wheel makes a turn every six seconds, and is alternately released and checked by the "pallets" or white sapphire stones seen in the ends of the cross-arm. At the end of the "lever" is the "fork" which is shown in this view but which receives motion from and imparts motion to the balance wheel through the "roller jewel" fixed to the balance *Center:* The smaller parts of a 16 size 21 jewel watch *Right* Balance and hair spring of 16 size 17 jewel watch considerably magnified The rim is made of two segments of steel and brass the steel being inside. Temperature changes cause these segments to curl slightly in or out thus compensating for the increase or decrease of elasticity of the hair-spring. The screws provide means for properly distributing the weight This little wheel makes 5 vibrations per second or over 157 000 000 per year turning on pivots slightly larger than a human hair A point on the rim travels nearly 5,000 miles a year

Enlarged photographs of the parts of a standard 16 size watch, showing the complexity of construction

The Heavens in August, 1921

Dark Voids in the Starry Skies, and What They Mean

By Prof. Henry Norris Russell, Ph.D.

As we look out into the summer skies, on any clear moonless summer evening, we cannot fail to notice the great brilliancy of the southern Milky Way. Almost *from Altair to the horizon, there is a long succession* of clouds and patches of light, whose brighter portions far exceed any other regions of the Galaxy which can be seen in our latitude.

Our first impression will probably be of the brightness, and the patchy character, of the luminosity. Upon a second and more careful survey, we will notice that all through this quarter of the heavens the Milky Way is double. Beside the conspicuous stream which first catches our eye there is another, further to our right, fainter, and in many places wider. Looking upward, we find that these two branches of the Milky Way may be traced northward beyond the celestial equator and all the way into Cygnus, where they blend with the single stream which we know in the winter skies. In the opposite direction the division of the Galaxy extends down to our horizon, and far beyond. Southern observers can follow it up to the Cross, where again the single band of light replaces the double.

Between the two branches of the Milky Way the sky is dark—fully as dark as the background of the heavens outside the Galaxy, and in places even darker. On a really clear night, when the zenith sky seems powdered with tiny stars, almost too faint for the eye to hold in direct vision, one may notice several of these dark regions. The most conspicuous one lies to the west and north of Sagittarius, where, on the edge of the bright star-clouds, there is a dark region several degrees long from which lanes almost as dark run westward—one nearly toward Antares, the other a few degrees higher up.

Another dark region, in Cygnus, which extends almost across the Milky Way, like a bar of cloud, is usually more conspicuous to one star-gazing, since it gets so much higher in the sky. It is only in clear, brilliant skies, such as may be found at mountain observatories, that the unaided eye can do much to detect these regions. A city sky, veiled with haze and illuminated by street lights, is almost hopeless.

What the Camera Tells Us

But the real extent and nature of these dull patches in the heavens is revealed only by photography. For our present knowledge we have to thank primarily the skill and assiduity of Professor Barnard, who has studied these objects for years, and gradually convinced the scientific world of the truth of his views.

Put briefly, his contention is this: that these dark regions are not holes in the star-clouds of the Milky Way, through which we see into the dark depths of space, but actual clouds of obscuring matter, between us and the Milky Way, which hide it and in places practically blot it out from the view of our earth-bound instruments.

The reality of this obscuration first becomes apparent in the case of the darkest markings, such as those between Sagittarius and Scorpio, in the southern part of Ophiuchus. Here the stars seems practically blotted out, so that there are regions where hardly one can be seen in the field of view of a great telescope—though, only a few degrees away, hundreds appear in a region of the sky of the same size.

It is only here and there that the "dark nebulae" are entirely opaque. More often a few scattering stars can be seen through them—probably greatly dimmed. They cannot be studied profitably with large telescopes—unless one wishes to examine some small and unusually sharp bit of detail. For the most part they are so big that only the wide-angle camera can display them, and a small instrument will then suffice. Photographs, exhibiting them as beautifully as the writer has ever known, have been shown by a colleague here, which were *obtained with a hand camera* (the lens of the highest grade), strapped to a telescope which served to keep it accurately pointed at the stars during exposures which often ran into many hours or even a whole night. With such an equipment it is hard to find any large region of the Milky Way in which there is not some evidence of obscuration, and in many places it is remarkable.

On looking at such a plate, one is moved to ask two questions. What are these vast dark clouds which come between us and the Milky Way? And where are they?

Bright Nebulae and Dark Regions

The second question is in some ways easier to answer. These obscured regions are permanent features of the heavens; hence they must be produced by something out among the stars. In many cases they are connected with regions of diffused visible nebulosity. For example, the dark lanes in Ophiuchus run up to the large patches of faint nebulosity which surround the stars Rho Ophiuchi and Nu Scorpii, in such a fashion that there can be no doubt that the luminous nebula is simply a part of the dark region, which is caused to shine for some reason connected with the presence of the stars about which the luminosity is condensed.

In these cases we may be practically sure that the nebulae, both bright and dark, are at substantially the same distance as these stars. In this way we can say with some assurance that the obscuring clouds in Ophiuchus are at a distance of about 400 light-years. Another prominent group of regions of obscuration appears to be connected with the bright stars in Orion, and the great nebula there; and we may estimate its distance as 600 light-years.

Still another such group lies in Taurus. The distance of this group, which is one of the largest and blackest of all, has been estimated by the Dutch astronomer Pannekoek in another way, by counting the number of faint stars per square degree in the dark regions and outside of them, and calculating, from our present knowledge of the distribution of the stars in space, at what distance the absorbing screen must be in order to obscure the observed proportions of the stars of the various magnitudes. He concludes that this screen is about 500 light-years distant.

These three great obscuring clouds are therefore near us, in comparison with the star-clouds of the Milky Way, whose distance may be roughly estimated as from twenty to fifty thousand light-years, if not more. It is, however, probable that there are many other and more remote dark clouds, which look smaller because of their distance.

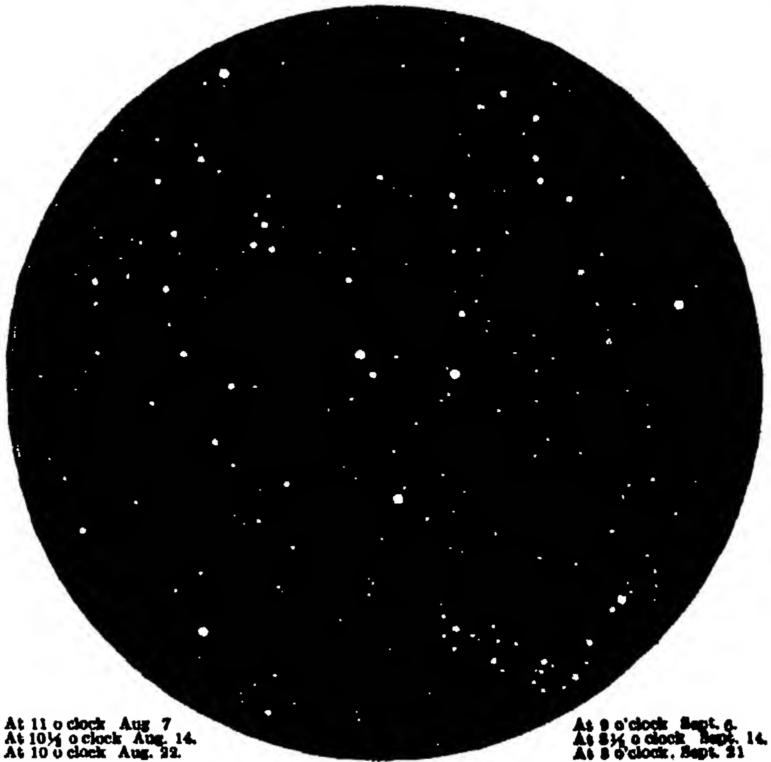
The Nature of the Dark Clouds

With regard to the true nature of these clouds, it is evident that they must be vast aggregates of some form of actual matter—and a very little consideration shows that the form of matter which is most effective must be fine dust. A cloud of fine particles—whether of actual dust or of the minute drops of water which constitute a fog—may be much more opaque in a few inches' thickness than all the many miles of air in our atmosphere. Larger particles, such as pebbles or rain drops, could also form an opaque cloud if there were enough of them, but calculation shows and common sense confirms that the same quantity of material, if broken up into smaller dust grains or drops, would suffice to make a far larger and denser cloud. If then in these dark nebulae we have actually a mixture of things, of all sizes—from great lumps of rock to separate molecules of gas—the fine dust particles and fine drops (of about the size of a wave length of light) will be so much the best cloud formers, pound for pound, that unless they are present in an extraordinarily small proportion they will account for most of the observed obscuration.

These clouds of cosmic dust, mixed with we know not how much gas or how many larger lumps of matter, are the hugest objects known to science. The great masses in Ophiuchus must be more than fifty light-years long and several light-years wide. Those in Orion are probably bigger, and Pannekoek estimates that the full extent of the cloud in Taurus is 200 light-years.

It is beginning to look probable that much, if not all, of the dark lane which runs down the Milky Way, and splits it in two for almost one-third of the circuit of the heavens, may be explained by similar obscuring matter, lying here and there, cloud behind cloud, and hiding from our eyes perhaps the grandest part of the stellar universe. Such a cloud mass must be thousands of light years in extent.

Of course, these vast clouds are not solid. They are probably incomparably less substantial than the thinnest terrestrial fog—for a few rods of the latter will absorb more light than a billion miles of the former. How they got there we need hardly ask. Of all things visible they seem nearest to the primeval chaos. Indeed, they might well be described in the scriptural phrase "without form and void . . . darkness upon the face of the deep."



At 11 o'clock Aug. 7
At 10½ o'clock Aug. 14.
At 10 o'clock Aug. 22.
At 9½ o'clock Aug. 29.
At 9 o'clock Sept. 6.
At 8½ o'clock Sept. 14.
At 8 o'clock, Sept. 21

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

NIGHT SKY: AUGUST AND SEPTEMBER

The Heavens

The region of the sky of which we have spoken is nearly in the south earlier in the evening, but well in the southwest at our hour of observation as indicated on the map. Scorpio is setting, with Sagittarius above on the left, and Aquila higher. Cygnus is right overhead; then, along the Galaxy, come Cepheus, Cassiopeia, and Perseus, low in the northeast. The Great Bear skims the northwestern horizon, with Draco and Ursa Minor above. Lyra is high in the west, with Hercules and Bootes below. Turning eastward we may see Pegasus and Andromeda, with Aquarius, Capricornus and the Southern Fish in the southeast.

The Planets

Mercury is a morning star at the beginning of the month, and rises at about 3.30 A. M. He soon draws in behind the sun and passes through conjunction [illegible] to reappear next month. Venus is a morning [illegible] and Cancer, rising before [illegible] the [illegible] of the month and about half an hour [illegible] close. Mars is a morning star, [illegible] the sun to be easily visible.

Jupiter and Saturn are evening stars and are [illegible] closer together in the sky [illegible]

(Continued on page [illegible])

Towing the Wrecked Car

WE are accustomed to the sight of an automobile being towed to the repair shop, with its chauffeur at the wheel to guide it in the tracks of the towing machine. But this procedure demands that the crippled car be towable—that is to say, that it have four good wheels and two good axles. When this demand is not met, some other means of getting the wreck to the hospital must be employed. It will doubtless be surprising to many readers to learn that it is by no means necessary, under these painful circumstances, to load the damaged car bodily on to a big truck. The fact is, it can be towed through the street with perfect ease, and actually without anybody at its steering wheel. The apparatus through which this result is attained is known to the garage man as the dolley. It is in effect a temporary substitute for the crippled front or rear axle assembly, or even for both, with this suggestion our photographs will make its construction and operation clear.

When the car to be towed has one axle intact the procedure is even simpler. Our first picture indicates what happens in this case, and represents what would appear to be the more unfavorable case, where the rear axle is the bad one, so that the towed car must proceed backward. The disadvantage is merely an apparent one, however, as will be realized when it is remembered that the dolley is attached to the towing car with sufficient rigidity to make the steering of the towed car quite superfluous.

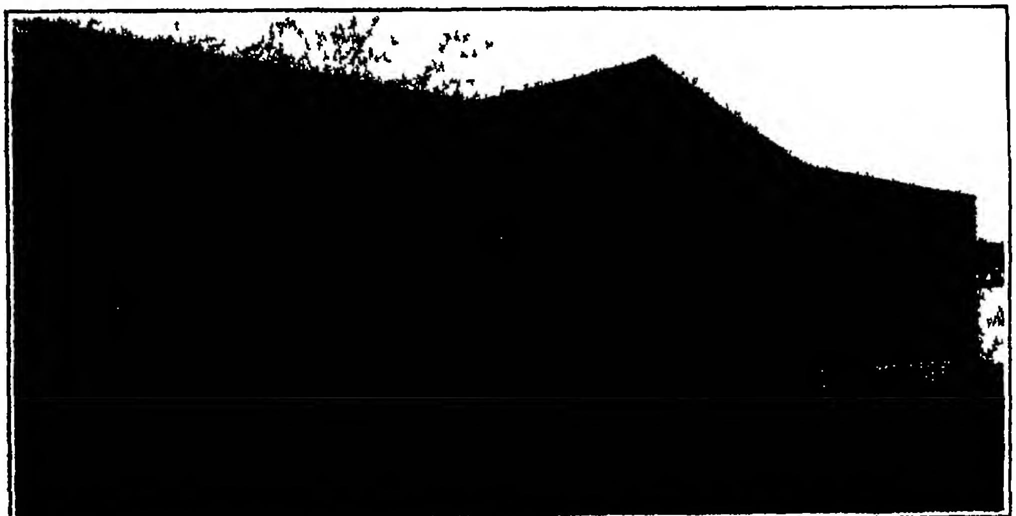
The automobile shown in the picture having four wheels wrecked, was towed to the garage without a driver at the wheel of the wrecked car. This was possible through the use of two dolleys as shown. The rear one is equipped with a telescoping tongue. This is placed under the rear axle and the telescoping tongue brought forward and attached to the front dolley where its end can be seen projecting through the bolster of the dolley that supports the front axle. A tripod has been designed especially for holding the dolley rigidly in the bed of the towing car. The tripod is permanently fastened to the bed of the service car, and holds the towing car dolley by means of a clamp which can be quickly opened for releasing the dolley from the car.

A One-Piece Welded Tubular Frame

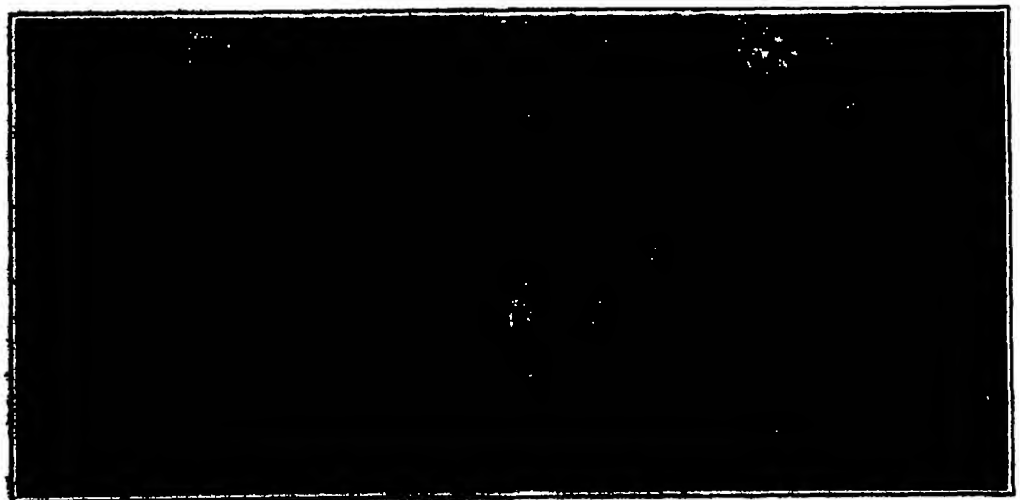
A [illegible] a new type of structure that has been developed recently in the [illegible], etc., point

The dolley car in use to tow a car with one bad end; the rear end, in this instance

How the towing dolleys are assembled beneath a car that requires support both in front and at the rear



Hangar door in Reno, Nev., which is so nicely counterbalanced that it can be opened by hand by one man



The frame of this building is of tubular steel, welded into a single piece without rivets, bolts or screws

strength and durability, economy of fabrication and exceptional sanitary features.

The truss welded frame structure differs from the heavy steel structures generally erected in that the framework is constructed of tubing in which the joints are made by welding. The completed frame is in reality one piece eliminating entirely the necessity for rivets, bolts, screws or screwed joints. The roof, sidewalls and floors may be of any building material desired. The design is such that buildings of any required dimension can be erected without interior pillars. The claim of superior strength is based on the use of tubing which under certain kinds of stresses is stronger than any other structural form of equal weight, and to the fact that the oxy-acetylene welded joint which is remarkably tough can be made even stronger than the sections of tubing joined, thus reinforcing the structural members instead of reducing their strength as is unavoidable where threads are cut for screwed connections or holes drilled for bolts or rivets. The smooth finish of the welded joints also renders them less susceptible to rust and deterioration, thereby adding to the factor of durability. Economy of fabrication both for material and labor is claimed on the basis of the saving in tonnage on any required factor of strength and on the fact that the welded joint can be made

(Continued on page 108)

New Type of Hangar Door

THE municipal hangar erected by the city of Reno, Nev., to house the air ships used in the transcontinental mail service is unique in having a monster one-piece door 18 feet high and nearly 100 feet long. This door extends across the entire front of the hangar whose dimensions are 100 by 100 feet inside clearance. When the door is open it forms an awning across the front. A five horsepower motor operates the door, which is of the Strauss bascule overhead counterbalanced type, the only one in operation in the United States. There is also a hand power chain block for operating it in case the electric motor fails. The door is so nicely balanced that one person can open and close it by hand power. The counterbalance is of concrete and weighs 37,000 pounds.

The hangar frame is of steel and the roofing and siding of asbestos. One-tenth of the roof and sides is of corrugated glass for lighting purposes, making an exceptionally well lighted building. By proper storing the building will house eight De Haviland 4 type of postal airplanes.

Preparing Bamboos for the Market

By H. L. Wright

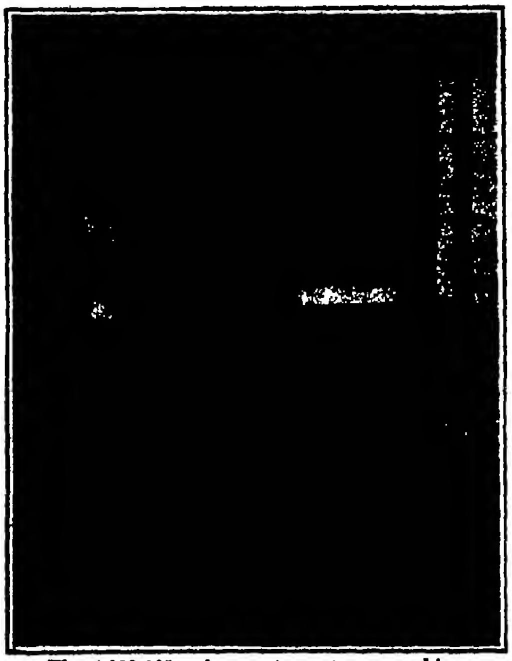
FEW forest operations in India are more interesting to watch than the preparations of raw bamboos for the market and the conversion of the rough, crooked, dirty looking stem as it comes from the forest into the highly polished, rich brown lance stave or tent pole. But though a remarkable change is effected in the process, the methods employed are extremely primitive. Nevertheless they are efficient and it is doubtful if better results could be obtained with more up-to-date appliances.

The first stage in conversion is to cut the stems to the proper length and to clean off all the knots. This is usually done by a gang of small boys armed with sharp adzes. Knot-cleaning is an operation requiring a certain amount of skill, as if the skin is broken the stem is ruined. But after a short period of apprenticeship, during which they work on the less valuable stems, the youngsters become remarkably good at this work and it is rare for them to spoil a bamboo by making a bad shot.

After dressing, the bamboos are handed over to skilled workmen, known as *kammaggars*, whose sole business in life is the preparation of bamboos. Each stem is then warmed in a hot wood fire made of two large logs. This not only makes it supple, but also imparts the fine brown color, and by melting the dirty waxy covering gives the stem a clean and polished appearance. Once the stem has become sufficiently pliable all curves and kinks are taken out by bending with some force in an opposite direction. For this purpose two implements are used. The first for heavy stems is an upright pole planted in the ground in which slanting holes have been bored to take the bamboo, the second a stout stick with a groove in it, which is used for lance staves and other delicate work. To use the first the warm bamboo is inserted in one of the holes and the *kammaggar* presses on it with considerable force to bend it in the right direction. When using the second implement the *kammaggar* holds the stem to be straightened in his left hand and goes carefully along its whole length with the straightener. In the case of lance staves, where perfect straightness is essential, firing and straightening have often to be performed several times before the desired result is obtained. The illustrations give a better idea of how these operations are performed than any description, and though they sound very simple, in reality considerable skill is necessary—first to make the bamboo sufficiently warm without allowing it to scorch, and then to straighten it without breaking the fibers.

Alcohol As Locomotive Fuel

FROM Pernambuco in Brazil comes the news that there are approximately 80 modern cane-sugar factories, which have about 800 miles of railway, of from 0.75 to a 1 meter gage, operated at present by wood burning locomotives. The fuel problem however is becoming a serious one and as a result the sugar mill operators are turning their attention to reducing wood consumption and finding substitutes. Consequently great interest is being shown in the substitution of alcohol which is produced in large quantities on the sugar plantations from the molasses finals. Pernambuco has recently adopted the use of alcohol to which 5 per cent gasoline has been added.



The 4,000,000-a-day postage-stamp machine

Dressing off the knots from the stems, another preliminary of straightening

Postage Stamps in the Making

By S. R. Winters

THE medical authority who visualizes a million germs, more or less, on the postage stamps you lick may have to revise his count if a machine designed by Benjamin R. Stickney, mechanic of the United States Bureau of Engraving and Printing, merits in ultimate applications that which its early triumphs foreshadow. The mechanism manufactures postage stamps with a negligible ratio of human assistance, and a heating process contributes to the sanitary make-up of the finished product.

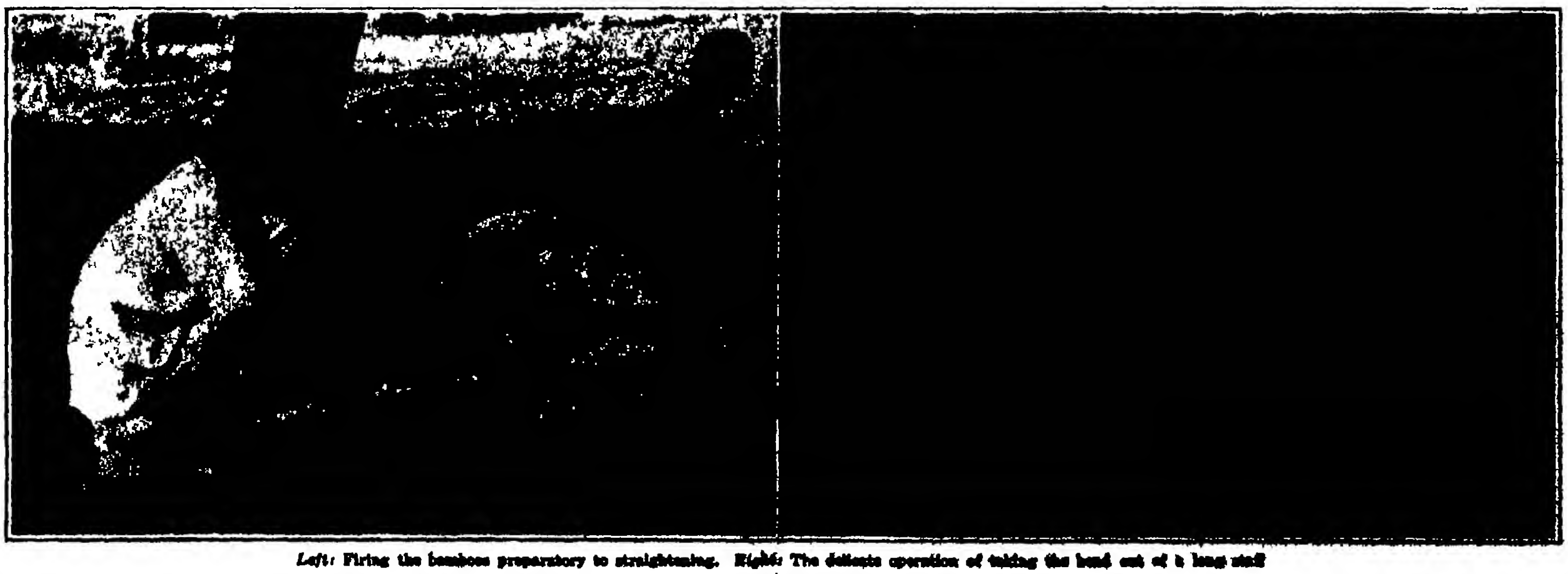
The so-called germ-proof method, evolved after seven years of unremitting effort, reduces the units of manufacturing operations from twenty-four to three. Three of the machines, already in operation, are capable of printing 12,000,000 stamps a day. Formerly, the postage tokens were finished in the form of sheets, the human touch being essential in divorcing the huge rolls into various units, or possibly, they might be marketed in book form.

The present-day vogue of stamp-vending machines and letter-stamping machines which have to have the stamps fed into them in endless coils a single stamp in width, however, has at once demanded a different mode of manufacture for the little engravings and made it possible to meet this demand. The stamps that are peddled out over the postoffice counter to the general public are still printed in sheets in substantially the same way as always, but the apparatus that we illustrate offers a far more expeditious, more economical and in general a more satisfactory process for printing and putting up the stamps of the coil variety. This process is as far removed from the old one as is the use of coils from the absurd cutting apart with scissors that was necessary with the unperforated sheets of stamps of 75 years ago.

By the new process, the stamps are printed, gummed, perforated and placed in rolls by machinery. When first printed, they are spun into rolls a foot long and a fraction less than one foot in diameter, the accumulation representing several thousand dollars worth. Forthwith they are separated into smaller units of 500 stamps and sealed. The inventor of the apparatus is credited with having designed in excess of 300 tons of machinery for application in various departments of the Bureau of Engraving and Printing. His scientific contributions have earned for him a substantial promotion as a government employee.

Stars of Composite Spectra

THE spectroscope is used in two ways to discover double stars too close to be separated by visual methods. In the case of ordinary spectroscopic binaries, the existence of a binary system is revealed by the shifting of the spectrum lines in consequence of varying radial velocity. There are other cases, however, in which the fact that a star is double is shown by a composite spectrum, *i.e.*, a spectrum produced by the superposition of two spectra of different types. Miss Cannon of Harvard Observatory has discovered 201 of these stars of composite spectra. Some of these are visual doubles, but in several such cases the companion star is too faint to give a spectrum.



Left: Firing the bamboos preparatory to straightening. *Right:* The delicate operation of taking the bend out of a long staff

Two steps in the preparation of bamboos for the market

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

The tripod that replaces the second saw-man

The One-Man Cross-Cut Saw

OBVIOUSLY, it would seem inconceivable to operate a wobbling cross-cut saw without two persons to manipulate it! But a district forester in the employ of the United States Forest Service on a western Government reservation, prompted by the exigency of a scarcity of manpower, has eliminated the necessity of having a second person to hold the saw while cutting firewood.

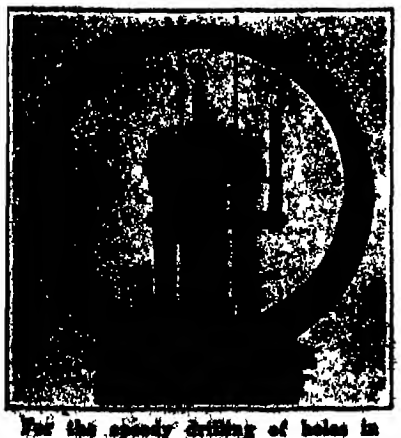
Obtaining three 2 by 4 scantlings, he fashioned then into a tripod like shape, boring a hole through the top of them for the passage of a bolt, for holding the pieces together. A fourth leg, shorter than the other three extends downward from the center of the tripod like arrangement. The latter does not reach the ground, and has a free and easy movement. One handle of the saw is fastened to this "fourth" leg, and as the firewood is placed in position in a rack for cutting the operator saws with a facility that one would conclude that a second person was on the scene.

The "short" leg is so arranged that it is easily swung back and forth at the will of the operator at the other end of the saw. That the clever device is practical can be surmised by observing the pile of wood that has been cut, as shown in the accompanying photograph. The ingenious device has attracted no little attention in the neighborhood of this forest ranger's tramping grounds.

A Rim Drilling Machine

A MASSACHUSETTS manufacturer is using a machine specially adapted for drilling operations on the inside of rims of various kinds. This machine will drill holes on the inside of rims having diameters of 20 inches and upward. The spindle has a total vertical movement of 5 inches and the vertical movement of the table is 3 inches. The table has a working service measuring 15 by 17 in., which is ample for its purpose.

Instead of the usual taper wedge arrangement the spindle has a knock out rod for removing drills and is hollow. Two oil holes at the top of the spindle mounting provide for the oiling of the spindle bearings and driving pulley. Convenient operation is attained by the reversible ratchet feed of the spindle. The machine was made low being only 50 inches in height, because of the special purpose for which it was designed.



For the speedy drilling of holes in rims of all sorts

The Plane That Blows Itself Along

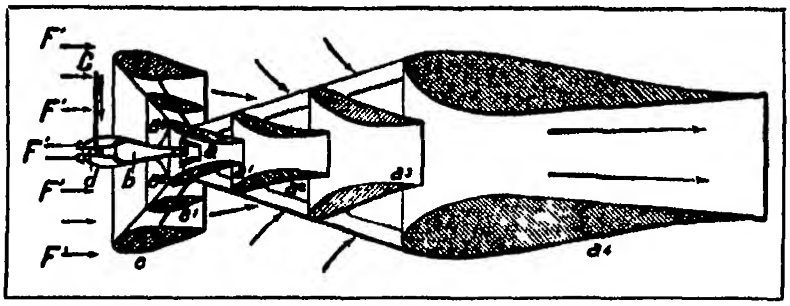
A FRENCH engineer, H. M. Mélot, has put out an invention which from its form he calls the propelling trumpet. Capable of application to all sorts of vehicles, it is designed primarily for the airplane. The apparatus consists of a number of tubes, ending with trumpet like flares or nozzles. These are arranged in series in connection with a combustion chamber, where an explosive mixture of air and fuel is ignited as in ordinary engine practice. The exhaust gases from the combustion chamber are discharged into the series of nozzles. Both the pipe that effects this distribution and the nozzles themselves, are carefully designed to cause the expansion of the gases to occur under the best circumstances. It is the velocity of the exhaust and the velocity of expansion which, through reaction against the external air, drives the machine forward.

The exhaust gases are discharged at a velocity of from 1200 to 1500 yards per second and at the entrance to each nozzle a certain amount of the outside air is drawn in and surrounds the jet of exhaust gas as perfectly as possible. The gas therefore gives up a part of its velocity to the air and causes a powerful suction action at the entrance to each nozzle. This is of material assistance to the direct reaction against the atmosphere behind the machine.

The attached drawing makes clear the operation of the system. The nozzles, indicated by the several a's of the drawing, are arranged one behind the other. In front of them is the combustion chamber into which the fuel gas is introduced by the pipe c. The air is delivered into this same chamber by a divergent tube d, placed preferably at the front of the plane. In front of the propulsor is an "expansion multiplicator", this comprises the divergent convergent member e, at whose narrowest section is the intake orifice of a second convergent-divergent conduit c, The system is composed of a number of similar conduits, similarly arranged with the inner orifice of each in the most contracted section of its predecessor. The rear ends e, e_1, of the conduits e_1, e_2, have either a convergent or a divergent form, as the case may be. Under these conditions when the plane is in motion air is drawn into the tube d in the direction of the arrows F. Since the tube is divergent the energy of the air velocity is partly transformed in it into energy of compression. At the entrance to the combustion chamber b there is therefore an excess of pressure as compared with that of the air. Furthermore the air is drawn into the entrance orifice of the first conduit a and its maximum expansion occurs in the narrowest section of this conduit. The expansion continues to increase up to the most contracted section of the following conduit e_1, and so on. Since the greatest expansion is thus produced in the conduit e_n there results a powerful exhaust in the exit tube of the combustion chamber. In this manner we have by comparatively simple means an auto-compression device which is not only very effective but which meets the requirements of the situation very well.

The Mélot apparatus was first tried out in 1918, the apparatus developing about 80 horsepower for a relative velocity of 50 meters (a trifle more than 50 yards) per second. The thermodynamic yield was definitely better than that of the ordinary internal combustion motor in present use. In the course of the tests this yield was brought up as high as 20 per cent though the nozzles and pipes used had been constructed without previous study and were by no means of the most advantageous design. These tests were made with compressed air, the auto-compressing device being a later addition.

We are indebted to *La Science et la Vie* for the facts and especially for the drawing which is reproduced herewith.



General scheme of the Melot system of propulsion through the agency of exhaust-gas velocity

A Wheel Alignment Indicator

IMPROPER alinement of the wheels of both passenger cars and trucks is costing the motoring public each year a needless expenditure of millions of dollars for tires. The man who is in the habit of noticing the car ahead knows that easily three out of four cars on the streets today have their wheels out of alinement due to bumping into the curbs, side thrust from deep ruts, car tracks, etc., improper adjustment of the tie rod, play in steering mechanism and wheel bearings and many other causes too numerous to mention.

Misalinement is without question the greatest preventable cause of tire wear. Its destructive effects are forcefully illustrated by the fact that if a 34-inch tire out of alinement one inch is run 3000 miles it will have been dragged sideways over 87 miles by the force of side thrust. No tires made can stand up under such excessive abuse which is now no longer excusable since it can be so easily remedied with the indicator.

In order to measure the alinement of the front or rear wheel, you drive one of the wheels in question over the plate. The resistance between the wheels is relieved by the movable plate which being mounted on two sets of roller bearings, is free to move inward or outward according as the wheel passes over it is toed in or out, while the other wheel rests on rigid ground. The movement of the plate is automatically communicated to hands on the dial which register to a fraction of an inch how much the wheels are toed in or out. The dial is calibrated for each size tire from 30 to 42 inches insuring the correct measurement of tires of all sizes. Both solid and pneumatic tires can be measured with equal accuracy.

The important feature of the indicator lies in the claim that it is the only device on the market which registers the alinement of a car while the latter is actually in motion.

Getting a line on the wobbly wheel

The Self-Contained Electric Brush

THERE is plenty of room for argument as to the merits of electrical therapy. Granted that it is desirable, however there can hardly be two opinions as to the practical value of the little brush illustrated herewith. The box on the back of the handle carries a battery of sufficient capacity to operate the device for an adequate time and makes the instrument self-contained and independent of all external wire connections. A connection for a massage roller is also furnished, so that the brush will give an electric massage as well as an electric brushing.

The electric brush that carries its own current

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

FLYING CRUISER.—N. G. C. A. Livengood, Territory of Alaska. The invention particularly relates to flying machines adapted for service in warfare and suitable for use at times as vessels capable of floating in water. Among the objects is to provide a device with extensible wings so arranged that the inner surface may be increased or diminished or may be virtually folded and thus rendered inactive, and to provide means whereby the propellers and rudders may be actuated and controlled by operators sitting at a distance therefrom.

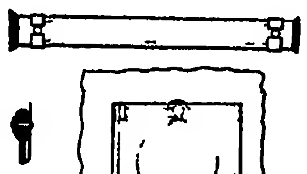
Electrical Devices

ELECTRIC FURNACE.—C. H. Priestly, P. O. Box 281, Elizabeth, N. J. An object of the invention is to provide an electrical furnace in which may be produced extremely high temperature and which furnace will be able to withstand increasing gas or air pressure incident to the generating of the temperature and at the same time employ pressure producing elements for preventing vaporization of the materials to be melted.

MAGNETO POCKET LAMP.—G. M. Beaudot, address Wm. Platz, c/o Palatine Industrial Co., 111 5th Ave., New York, N. Y. The invention relates to a lamp in which the light is produced by a small magneto to which is imparted rotary movement. The device consists substantially in a push piece capable of taking a to and fro movement at right angles the pressure causing successive impulses on the mechanism thus imparting to the armature a continuous rotary movement.

Of General Interest

SAFETY WATCH POCKET PROTECTOR.—L. Jurgielewicz, Genl. Delivery, Los Angeles, Cal. This invention has for its object to provide a pocket protector for use in connection with pockets upon garments for the



SHOWING HOW THE STRIP IS CONSTRUCTED AND APPLIED

purpose of promoting the safety of the contents of the garment. The device comprises a metal spring strip with a piece of fabric folded and secured upon the strip and connected to the pocket edge either by sewing or rivets.

DUST BAG.—R. A. Nearon, 27 W. 24th St., New York, N. Y. Among the objects of this invention is to provide a dust bag designed for household use and arranged to permit of readily shaking off the dust from a dry mopping duster and retain the dust without danger of its escaping back into the room. The bag may be readily carried from room to room and may be temporarily supported from a door knob or similar support.

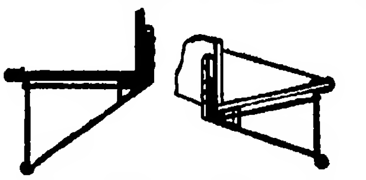
CONTAINER.—J. I. Hampton, 1081 Broadway, c/o King Fire Co., New York, N. Y. The invention relates to containers for fire extinguishing fluid and has for an object to provide a construction wherein the fluid is maintained sealed under ordinary circumstances but which may be unsealed and the contents opened quickly the body of the container being frictionally held against the lid in such manner as to be readily removed by a swinging lateral movement.

OIL CAN.—A. E. Kammerits, 482 Franklin Ave., Hartford, Conn. The object is to provide a device of this character having means for detachably connecting the spout or nozzle with the body in such manner that it will be firmly locked to the body with a fluid tight joint and wherein there will be no possibility of accidental dislodgment of the spout or nozzle.

FIGURE FOR BALLROOM DANCING PRACTICE.—S. E. Feist, 1050 Broadway, Brooklyn, N. Y. This invention has for an object to provide a device which may be used by a pupil on a ballroom floor for practice. Another object is to provide an adjustable figure to properly coact with any sized student in learning to properly maneuver a part for when dancing on a ballroom floor.

INK BOTTLE.—Mary L. Kaiser, Tyler, Texas. This invention has reference more particularly to an ink bottle and holder both of which are screw threaded so that the bottle may be removed from its holder for the purpose of cleaning or refilling the holder being permanently fastened to a desk or other object. The device serves to prevent accidental displacement of the bottle.

BRACKET.—C. H. Paschke, 133 Baynes St., Buffalo, N. Y. The invention relates to brackets especially adapted for supporting a towel rack in spaced relation to the shelf. An



A SIDE ELEVATION AND PERSPECTIVE

object of this bracket is to provide means whereby shelves of different widths may be supported beneath a mirror or the like. The device is simple to apply and is neat in appearance and may be used either as a bracket for mirrors walls or windows.

FOLDING TABLE.—G. J. Kohn, 420 W. Missouri St., Kirksville, Mo. The invention has for its object to provide a table which may be folded into a body having the form and approximately the dimensions of a suit case or which may be opened out into a flat top table wherein the elements are securely braced so that there is no possibility of collapse.

WINDOW GUARD.—B. C. Patterson, 169 Cedar Ave., Memphis, Tenn. An object of the invention is to provide an automatically opening curtain of a slatted type for use in connection with store or display windows and normally controlled and held in a practically concealed position together with means for automatically locking the same in lower effective position covering the window space.

RECEIVING ACCOUNT CHECK.—J. Biis, Box 46, Castlewood, S. Dak. The invention relates more particularly to check books or pads for produce receiving stations such as creameries or other receiving stations where many checks are written and speed and accuracy are essential the object being to simplify the payment of accounts, issuance of receipts and entry of receipts performing these three operations practically as one.

GLOVE FINGER SUPPORTING TUBE.—D. Baum, c/o The Livermore Falls Glove Co., Livermore Falls, Me. More particularly this invention relates to a tube which is designed to support and facilitate the turning of the finger and hence the turning of the glove. An object is to provide a device which is adapted for use in connection with cotton, leather or combined cotton and leather gloves having flexible fingers.

SHELL FISH SCRAPER.—C. S. Price, 1643 Champa St., Denver, Colo. This invention is more particularly designed as an article for table use to accompany the usual knife and fork and to take the place of the so-called "oyster fork." The scraper loosens and

A GENERAL VIEW OF THE SCRAPER

scrapes clean the meat adhering to the inside of claw parts or shells on to the service plate. It is not intended to eat with. It can be conveniently used in connection with lobsters and shell fish generally. The handle may be made to match the various silverware services.

TOUPEE AND WIG RETAINER.—J. C. Tapscott, Box 1046, El Paso, Texas. This invention relates to the manner in which a wig or toupee is retained in place on the head the prime object is to provide an arrangement which will avoid the use of double faced adhesives for this purpose by substituting a single faced adhesive whose adhesive face is turned inwardly for engaging the scalp and which is provided with spurs on the upper surface for retaining the wig.

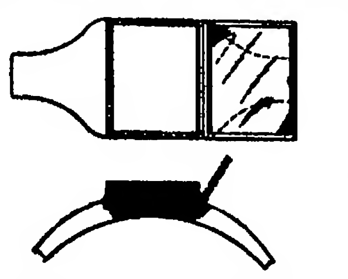
REFRIGERATOR.—M. Cohen, c/o Mrs. Weinstein, 636 E. 13th St., New York, N. Y. This invention relates to refrigerators of the general type employed in households, small stores, and the like more especially the invention relates to a refrigerator in which the drip from the ice is received in a tank within the refrigerator that the cooling action of the water and the water itself may be utilized.

DUPLEX PICTURE.—F. Meeks, 148 S. Broadway, Los Angeles, Cal. An object of the invention is to provide a duplex picture frame arranged with a glass or transparent parcel and provided with a space between the picture and the panel adapted to accommodate sand or other movable material therebetween and to prevent its escape and with means for suspending the picture in inverted position so that different scenes will be independently exhibited.

KEY RING CHAIN.—C. H. Otis, 62 Hawthorne St., Hartford, Conn. An object of this invention is to provide a chain construction and coupling means for holding the ends of the chain together. A further object is to provide a coupling device which is primarily adapted for use on key ring chains but which can be conveniently used on various types of chains or other articles.

CUFF BUTTON.—M. J. Sullivan, P. O. Box 197, Holyoke, Mass. The object of this invention is to provide a cuff button which is extremely simple in construction, in which a separable connection between the parts is effected which will permit of the ready detachment of one of the sections from the other although at the same time holding these sections against any accidental detachment.

FINGER RING AND PHOTO-MOUNT FOR THE SAME.—Nannie K. Hunt, Petroleum, Ky. The invention relates to an ornamental finger ring and has for its object to provide a device to be worn in the usual way, and



SHOWING A PLAN VIEW AND SECTION

provided at the top with a photo-receiving recess and a transparent cover for the same. The device comprises a finger embracing band having an enlarged top portion as in a signet ring and a cover comprising a rectangular frame and a glass panel carried by the frame.

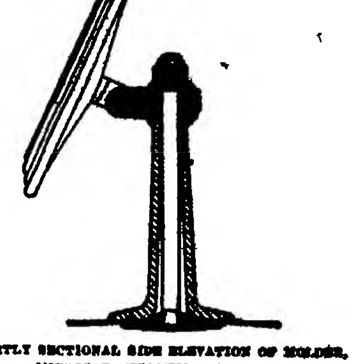
HAT HOLDER.—J. S. Allen, 229 W. 101st St., New York, N. Y. Among the objects of the invention is to provide a device which is designed to efficiently support a hat in the top of an automobile and the like and which can be easily and quickly placed in operation or removed therefrom. The device can be manufactured and sold at an extremely low price.

ATTACHMENT FOR TAPE MEASURE.—G. A. Brandenburg, 1167 Champa St., Denver, Colo. The invention is more particularly intended for use in connection with a form of tape arranged to wind within a case. The general object is to provide means at the end of the tape adapted to be employed for securing the same by pinning it down or causing it to grip a fixed object thereby making it unnecessary for a second person to be present to hold the line at one end.

COMBINED SHAVING MIRROR AND CABINET.—C. Lichtenberg, 1137 Green Ave., Brooklyn, N. Y. The object of the invention is to provide a mirror with a sliding cabinet behind. The mirror may be moved into various positions to adequately reflect light from any source. The cabinet may be opened either side of the mirror and can be used regardless of the position of the mirror. The cabinet is intended for toilet articles, the mirror being particularly adapted for shaving and adjusting the hair.

AIR DRAFT MOTOR.—G. Berry, Box 366, Checotah, Okla. Among the objects of the invention is to provide a portable air motor, being very light it can be carried about and set up wherever required for the purpose of running fans, ventilating rooms, etc. A further object is to provide a draft motor with a long draft tube or flue, arranged to be supported in any suitable manner while the device is in operation, but which can be telescoped so as to make the apparatus portable.

HOLDER FOR MIRRORS AND OTHER ARTICLES.—H. A. Dreyer, 278 Atlantic Ave., Brooklyn, N. Y. The general object of the invention is to provide a holder embodying a



A PARTLY SECTIONAL SIDE ELEVATION OF HOLDER, MIRROR POSITIONED THEREON

standard and clamping means in coaction with the standard to clamp the holder in position on a fender or support and constituting also means to clamp in place on the standard a bracket for holding a mirror or other article.

FLYTRAP.—W. S. Wallace, address L. C. Wallace, 91 St. Marks Ave., Brooklyn, N. Y. An object of this invention is to provide a fly trap arranged to insure a proper transfer of the flies or other insects from the bait to the revolving cage without crushing the insects on the bait and thus spoiling the latter. Another object is to permit of conveniently removing the cage from the trap without danger of the captured flies escaping.

Hardware and Tools

TWEEZERS.—E. H. Metcalf, Masboro, N. H. An object of the invention is to provide a construction of tweezer, cut from a single metal blank forming a pair of spring jaws movable toward and away from each other by means of a removable finger operating lever for controlling the operation of the jaws. A further object is to provide a tweezer which can be manufactured and sold at a low price.

GATE HINGE.—R. P. Billican, Natchez, Miss. Among the objects of the invention is to so construct the hinges used upon a gate that the gate will always be properly closed. The device comprises a hinge connecting the fence and gate, and includes a hinge pin, a pulley mounted on the hinge pin, a coiled spring connecting the fence and gate and means associated with the fence to regulate the tension on the spring.

Machines and Mechanical Devices

ROD SOCKET OR COUPLING.—J. A. Day, Oilfields, Cal. The principal object of this invention is to produce a rod socket which may be lowered into an oil well for the purpose of recovering a broken sucker rod, which may be lost within the well. Another object is to produce a rod socket which is simple and which may be operated by an inexperienced person.

BALL BEARING.—W. H. Tinsley, 154 Nassau St., New York, N. Y. The particular object is to provide a type of ball bearing capable of taking radial loads, combined radial and thrust loads, and end thrust loads [illegible] from either direction to enable the use of the bearing in all types of machinery where it becomes necessary to provide bearing facilities for a variety of [illegible].

OIL WELL SCREEN AND LINER CLEANER.—L. Ri[illegible], Winfield, La. This invention has for its object to provide a device by means of which the screen and liner of a well may be easily and efficiently cleaned [illegible] within by means of jets of water [illegible] through the screen and [illegible] provided for loosening the [illegible] of the screen to remove sand left in the formation of the same.

CLUTCH.—W. S. [illegible], Box 1069, [illegible], Territory of Alaska. The object of the invention [illegible]

(Concluded on page [illegible])

The Radio Compass and Navigation

(Continued from page 89)

navigator of any vessel fitted with the radio compass can then take definite bearings to learn the position of his ship even though his guiding aids are unseen

At the start, trouble was encountered when two or more stations were generating signals at the same time When the receiving apparatus, in picking up wireless waves from one lighthouse, had been rotated so as to give minimum audibility, i e, had been swung at right angles to the waves of the transmitting set, not infrequently that minimum was 'drowned' or confused by the arrival of a louder signal from another dispatching point. This difficulty has now been overcome in a simple manner For instance in approaching the Port of New York Ambrose Channel and Fire Island light vessels and the light station at Sea Girt New Jersey propagate distinctive signals The Ambrose Channel craft sends one dash periodically, the Fire Island ship uses a group of two dashes, while Sea Girt employs a group of three dashes By reason of these variations, which for the nonce are substituted for visible flashes of white or colored lights, the mariner off shore can establish definitely the direction and identity of the source of the radio waves and thus secure a bearing in thick weather If the navigator has two or more such aids the chance of error in fixing the position of his ship is reduced proportionately, the intersecting lines forming angles that check one another when referred to his chart.

From what has been said of the basic phenomenon involved in the use of the radio compass, it may be asked by the uninformed, 'How does the mariner discover the geographical situation of the sending station, for, even though the receiving apparatus discloses the line on which the station lies, he may still be at a loss as to its location east or west of him, for instance? This initial shortcoming of the radio compass for service afloat has been disposed of by equipping the instrument with a unidirectional feature This is a simple adjunct which renders it possible to pick up a signal's maximum audibility at only one point and that when the recording hand is pointed right at the generating station Where radio compasses are set up ashore the unidirectional feature is not required because the observer knows that signals from shipping must, of necessity, originate off the coast

The present compass was invented by Mr F A. Kolster of the Bureau of Standards, and its employment was suggested by him to the Bureau of Lighthouses in 1916. Some experiments were made early in 1917 with the system, but our entry into the World War interrupted further tests Two years later the investigations were resumed, and, as a result of these and improvements made because of them, there has since been evolved apparatus of a highly efficient type The 'coil aerial consists of ten turns of high frequency wire spaced one centimeter apart and wound around a rotatable frame approximately four feet square Associated with this antenna there is a variable tuning condenser which is connected across the terminals of the compass coil The primary of the air-core transformer is connected to the terminals of a condenser by means of slip rings. The amplifier is then connected to the terminals of the secondary coil of the transformer

The coil aerial is mounted upon a vertical spindle fitted with a pointer, and a graduated circle beneath that index determines the angle of the coil with respect to a known direction In the installations which have been made aboard [illegible] the coil aerial is on the [illegible]. The spindle [illegible] the [illegible] and is equipped [illegible] rotating the coil. [illegible] the spindle terminates [illegible] a standard ship's binnacle and carries a pointer so arranged that the position of the coil may be read directly upon the compass card, thus giving the magnetic bearing of the radio-signal station at a glance as soon as the minimum point of signal audibility is reached.

The transmitting apparatus whether located at a lighthouse or placed aboard a lightship, is of a commercial type simple and rugged in construction and of about 1 kilowatt power In addition each set has a special automatic motor-driven timing switch for producing the desired signal at regular intervals The antennæ at sending stations are the same as those used for ordinary radio communication The wave length at present employed is of 1000 meters the existing international standard for such signals and the range of effectiveness varies from 30 to 100 miles depending upon the sensitiveness of the receiving apparatus

Where vessels are guided in thick weather by means of radio compasses set up on shore a group of land stations co operating can help only one ship at a time and the coordination of the readings of several of these stations takes some while By the newer system any boat possessing a radio compass installation can make her own determinations of her position as often as she likes when within the receiving range of automatic and continuously propagated signals emanating from one or more lighthouses etc The operation of the radio fog signaling apparatus requires no additional personnel at lighthouses or lightships It is a matter of only a moment to bring the wireless wave generating mechanism into action

It is the intention of the Lighthouse Service after a suitable trial period of the present group of stations in the vicinity of the Port of New York to install kindred groups at the approaches of other important harbors on the Atlantic and the Pacific coasts as well as along the shores of the Great Lakes

Depth Bombing from the Air

(Continued from page 93)

had fallen clear, there appeared all around the waterline at the stern of the vessel and well up toward amidships a white line of foam boiling around the vessel, broken occasionally on both sides of the stern by bursts of foaming water

There was but one interpretation of this phenomenon It meant that not only the port side but also much of the bottom of the ship must have been broken in and that this disturbance was caused by the escape of vast volumes of air from the wrecked underbody as the water rushed in Immediately the great ship began to list to port turning steadily over as the afterbody of the ship submerged When the bow of the vessel struck the bottom some 300 or 350 feet below the sinking was arrested and the ship seemed to hang for a few moments before the stern took the final plunge and disappeared Just after she had gone down, the Handley Page bomber flew over the circular patch of still foaming water and dropped the last of the 2000-pound bombs thus sounding taps over this marine burial

Don't Draw Wrong Conclusions

It is not to be wondered at if to the lay mind, this majestic spectacle should have had but one immediate meaning and express itself in the all too-common phrase "That seals the doom of big battleship construction. As a matter of fact, it means nothing of the kind Naval and military men knew perfectly well that 1000 pounds of TNT detonated near the side of such a ship as the 'Ostfriesland would be pretty certain to send her down Whether it would have done the same to the flagship 'Pennsylvania' which floated not far away, is a mooted question Subdivision has made wonderful strides in the last ten years. That bomb might possibly have sunk the "Pennsylvania," It is certain that it would have put her out of action for the time being.

RECENTLY PATENTED INVENTIONS

(*Continued from page 104*)

tion is to provide a reversible frictional clutch for use in mobile or stationary machinery, wherein the speed forward and backward may be obtained by merely moving the clutch operating mechanism in opposite directions. When the operating parts of the clutch are in neutral position the driving shaft rotates freely without imparting motion to the driven shaft

Prime Movers and Their Accessories

TESTING DEVICE FOR IGNITION SYSTEM.—H F MAUCIRE, 168 East End Ave., New York, N Y The invention has reference more particularly to a testing device for jump spark ignition systems which are commonly used for the firing of explosive charge of internal combustion engines. The device is especially applicable to an ignition system which employs a series of spark coils, one of which being provided for each cylinder of the engine

GAS GENERATOR.—M BOISEN 1511 Camp St., Sandusky Ohio. The invention relates to an apparatus for decomposing water so as to generate oxygen and hydrogen and direct these gases into separate tanks, and afterward commingled in the desired proportions for use the use being primarily intended for internal combustion engines. The decomposing tank and the operation of the generator are automatic, the pressure in the tanks controlling the level of water so as to stop and start decomposing automatically

Railways and Their Accessories

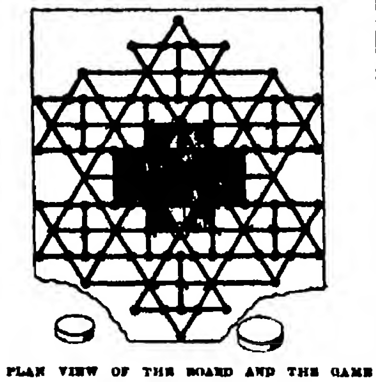
COMBINATION LOCK AND CONTROLLER FOR SIDE DOORS OF BOX CARS.—F H WARD, Washington D C The object of the invention is to provide a construction in which the doors of the car are constrained to corresponding movement whereby when one of the doors is secured in desired position the other is automatically secured in corresponding position and in which manipulation of the doors by an unauthorized person is effectively precluded. The device is simple and durable, and inexpensive to manufacture

FREIGHT CAR DOOR.—L. W MANHEIM, Box 182, Camden, S C An object of the invention is to provide a door construction which will greatly facilitate the loading and unloading of the car A further object is to provide side and end doors hinged at their lower edge and adapted to swing outwardly and to provide means for controlling the position of the doors so that they may be used either for platforms or runways.

SPIKE PULLER.—J R. ERICKSON, address C D. Symonds, Iron Mountain, Mich The invention relates to a device which facilitates the removal of spikes and which employs a lever positioned parallel with the the rail and operates to remove the spike from either side of a rail The device is especially adapted for use on bridges, trestles, and elevator work where it is difficult to employ the ordinary type of spike puller

Pertaining to Recreation

GAME.—C R MULLINS JR., R.F.D No. 3, Oklahoma City, Okla. Among the objects is to provide a game of that class which comprises a checker board and a plurality of playing pieces An object is the provision of



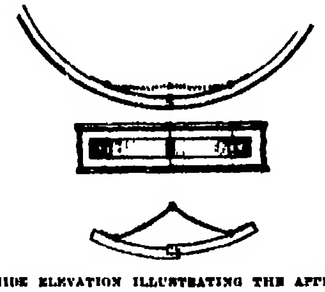
A PLAN VIEW OF THE BOARD AND THE GAME PIECES

a game which will require two groups of players with the players of each group operating a plurality of game pieces to combat their skill in defeating the other group

VELOCIPEDE.—C R. HORNIG, 309 Market St., Perth Amboy, N J An object of the invention is to provide a velocipede which is propelled by means of a crank shaft constituting the rear axle and to which motion is imparted by the movement of the body and legs of the rider The action of the propulsion requires the rider to simulate the motions which occur during horseback riding.

Pertaining to Vehicles

DEMOUNTABLE TIRE RIM.—L. D ALLEN, 2273 Pine St, San Francisco, Cal. An object of the invention is to provide a practical and convenient manner for removing and applying a pneumatic tire to the rim A further object is to so construct the rim that a tire may be removed from and applied thereto without the use of tools or an undue amount of effort



A SIDE ELEVATION ILLUSTRATING THE APPLICATION OF THE DEVICE

SHOCK ABSORBER.—P DU FORD, address W E Lees, Ontario, Oregon An object of the invention is the provision of shock absorbing means for use in connection with or without the ordinary leaf spring, either semi-elliptic or full elliptic, whereby to increase the range of relative movement of the spring controlled parts without curtailing or impairing the normal function and operation of the leaf spring where present. The invention will automatically take care of the variation of the load.

TRANSMISSION BAND.—H F HONS, JR., San Francisco, Cal. The invention has reference more particularly to a so-called straining ear for transmission bands as commonly used in Ford automobiles The device is applicable for use in connection with either one of the three rotating drums, namely the low speed, reverse, and brake employed in the planetary transmission system.

SHACKLE.—G R. ROBERTSON, address O K Cain, Cheshire House Block, Keene, N H Among the objects of the invention is to provide a shackle primarily for connecting one vehicle to another, but not necessarily limited to this adaption, and by means of which any possibility of an accidental disconnecting of these elements is reduced to a minimum. The parts may be coupled with great facility, by certain operating means at a point relatively remote from the shackle itself

GRADOMETER.—S W HALL, c/o S A. Public Serv Co., 305 E Houston St., San Antonio, Tex. It is a purpose of the invention to provide a gradometer which is particularly adapted for use on motor vehicles, and which will accurately indicate under the most varying and unstable conditions the inclination and declination at which any moving body is traveling

DEMOUNTABLE RIM.—L. U STRONGE and R. SCHMERFELD, Canyonville, Ore. The object is to provide a rim which can be quickly attached to, or removed from, the felly of a wheel, which will involve no change in the size or form or balance of the wheels, in which the rim can be changed without changing the locking device therefor, which will take up the natural wear and which will insure alignment of the tire

COMBINATION LOCK FOR AUTOMOBILES.—A H BUCKLEY 58 W Ontario St., Chicago, Ill. Among the objects is to provide a device by means of which an auxiliary valve in the fuel feed line of an automobile engine may be locked in position so as to shut off the flow of fuel, and thereby prevent the operation of the engine. A further object is to provide a device in which the movement of a single lever in one direction will instantly bring the auxiliary valve into locked position

OVERHEAD VALVE.—W H. and P M. PAYNE, c/o W B. Moore Co, 706 Union Bank Bldg, Pittsburgh, Pa. This invention relates more particularly to a valve for automobiles, having as its object the elimination of rattling and noisy contact between the valve operating parts of the overhead valves. The purpose is to eliminate the metal to metal contact and provide means for holding the rocker arm in yielding engagement with the valve stem at all times.

DUMPING TRUCK.—F M. GOODSON, c/o Butler Coupling Co., Hillsboro, Kans. This invention has for its object to provide a body which is suited for use with motor trucks or animal-drawn vehicles, and to provide for locking the body in horizontal position, on the truck. A further object is to provide a construction of dumping truck which will be sturdy and durable, simple, and easily manually operated.

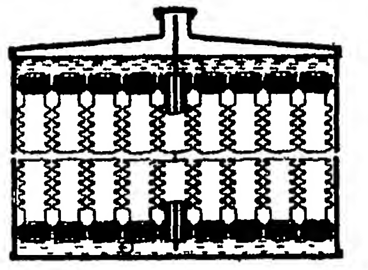
SEAT FOR VEHICLES OR THE LIKE.—G V BARNES, Alameda, Cal. The invention relates to a seat mounting or suspension The prime object is to provide means for absorbing, so to speak, lateral jolts and shocks experienced in a vehicle such as an automobile which are not taken up or absorbed by the springs of the vehicle.

AUTOMOBILE PLATE AND HOLDER.—J BILLINGS, 13 Park Row, New York, N Y The invention relates to an attachment in the nature of a "stop thief" device, and is designed to deter the unauthorized use of the vehicle. The device is provided with means for attaching to a wind shield a legend such as "Watched" and it is so arranged that the sign may indicate to the police or others that any use of the vehicle is unauthorized. An individual cover for each particular legend holder is provided so that it cannot be concealed except by the owner

AUTOMOBILE WHEEL LOCKING DEVICE.—L. E. TRIMM, 465 E 29th St Brooklyn, N Y An object of the invention is to provide a construction in which a large device is utilized as means for preventing the rotation of one or more wheels. The device is provided with two flat sides and a clamping means so that it may act as a skid in case it is attempted to move the automobile.

TRANSMISSION GEAR.—C BRANDES, 106 Bank St, New York, N Y The general object is to provide an automatic gear shift, whereby if in starting, going up hill, or otherwise running under heavy load and direct drive, should the speed be too high for starting or overcoming the resistance without shock, the gearing will be automatically thrown out of high gear and into lower gear to start or continue under the latter

RADIATOR.—A. NEBEL, 794 Knickerbocker Ave., New York, N Y The invention relates to liquid cooling devices, and is particularly adapted for use as a radiator for automobiles, but may be used wherever it is desirable to cool a circulating liquid Among the objects is to provide a radiator having its parts so constructed as to bring the circulating fluid in contact with a large exposed surface whereby the liquid may be effectively cooled, in a limited space



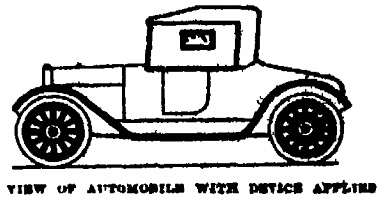
A VIEW PARTLY IN SECTION, SHOWING THE ARRANGEMENT OF TUBES

HEADLIGHT.—H. F HAMMOND, address N A Sirace, 116 Main St., Whitehall, N Y An object of the invention is to provide an attachment for ordinary headlights which will operate to prevent glare but allow full road illumination A further object is to provide a device which is of transparent colored material so as to color the light rays which are thrown upwardly and at the same time permit a full glare of uncolored light on the road.

DIRECTION INDICATING APPARATUS FOR AUTOMOBILES.—L. W SIMMONS, Forest Lake, Minn. Among the objects is to provide means embodying a signal device arranged at the front or rear of an automobile for indicating the direction in which the automobile is to be turned, such means being actuated by elements arranged on the dash, or other conveniently located portion of the car The device is manually thrown into operation and automatically returns to the normal condition.

GREASE GUN.—J OWENS, 1057 Jefferson St., N W., Washington, D. C. This invention relates more particularly to portable hand grease guns whose most common function is the feeding of grease lubricant to the transmission and differential casings as well as the universal joints of automobiles. This device is characterized by its simplicity, strength and durability

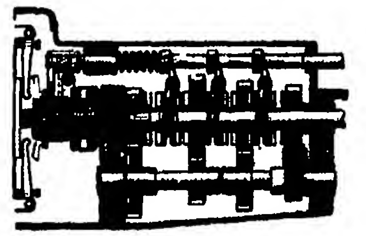
CURTAIN WINDOW.—C. B. PECK, Batavia, N. Y The invention especially relates to windows which are adapted to be used in the side curtains and rear covering of automobiles: an object is to provide a detachable glass window which will take the place of the flexible material now in general use. A further object is to provide a window which may be inserted in any ordinary automobile curtain, which will be durable, of light weight, and readily replaced.



A VIEW OF AUTOMOBILE WITH DEVICE APPLIED

PNEUMATIC TIRE.—J GUAGLIARDO, R.F.D, Box 16, Hammond, La. The object is to provide a construction which will obviate the necessity of the inner tubes and which, while it will not eliminate puncture, will at least avoid the necessity of immediate change of tires and will permit the user to proceed for a time with little discomfort and without danger of destruction of the tire.

TRANSMISSION GEARING.—W. S. CUNNINGHAM, 2037 Elizabeth St., Shreveport, La. An object of the invention is to provide a transmission gearing in which the gears are always in mesh, and there is no danger of stripping of gears by the shifting of the clutches. The operation is by an arrangement of clutches controlled by foot levers very much as the foot levers of an ordinary Ford control with the exception that an additional lever is provided to give an intermediate speed.



A VIEW IN LONGITUDINAL SECTION

CONVERTIBLE AUTOMOBILE TOP.—R B. ELLSBERRY, 156 6th St., S. W., Washington, D. C. The invention relates more particularly to rigid tops, especially for two-passenger vehicles the object is to provide an arrangement whereby the top with or without sliding, swinging, or otherwise mounted windows may be shifted bodily on connections with the vehicle into and out of effective position from the vehicle seat, the top in inoperative position being located rearwardly of the seat.

Designs

DESIGN FOR A MIXING AND STIRRING DEVICE.—M BLACK, 890 Putnam Ave., Brooklyn, N Y

DESIGN FOR A DIRECTION INDICATOR.—IVY D. HOWELL, 12 Church St., Ballston Spa, N Y

DESIGN FOR A SIFTER TOP FOR A POWDER CAN OR SIMILAR RECEPTACLE.—C. S. HUMPHREY, c/o Manhattan Can Co., Bush Terminal, No. 10, Brooklyn, N Y

DESIGN FOR A KNIFE AND FORK CLEANER.—J J GOTTFRIED, 930 E. 15th St., Brooklyn, N. Y

DESIGN FOR A RECEPTACLE PLUG.—P R. COLLINS, 202 Sumac St., Wissahickon, Philadelphia, Pa.

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Dead Men's Fingers

(Continued from page 94)

quite similar to the elegant stinkhorn in color and structure, but is club-shaped, tapering toward the base rather than toward the apex, and is much rarer, occurring in old fields in clay soil practically destitute of leaf mold or in grassy ground partly shaded

The only European species of this genus, *Mutinus caninus*, has a slender, cylindric stem which tapers in neither direction, and a small cap that is set off rather sharply from the stem, differing in this respect quite decidedly from the elegant stinkhorn although resembling it in color and general form It has been reported a few times from the United States, but I have seen no American specimens It would give me much pleasure to receive some This species has a very faint odor, and the stem sometimes varies to white All the species of Mutinus readily lose the greenish slime containing the spores since it is eagerly devoured by flies and easily washed away by light rains.

The branched stinkhorn, *Lysurus borealis* grows solitary or clustered, 10-12 centimeters high, stem white, divided above usually into six but sometimes five or seven, narrowly lanceolate hollow arms, which are incurved above, with pale flesh colored backs traversed their entire length by a shallow furrow cavity of the stem nearly closed at the base of the arms by a diaphragm through which there is an opening upward into a closed chamber with a dome-shaped wall, gleba supported on the dome and closely embraced by the arms, spores oblong, white eggs clustered 3.5-4 centimeters in diameter

The odor of the mature plant is very vile and penetrating at close range somewhat resembling that of fresh guano, but it is not pervading like that of the veiled stinkhorn for example, and also lacks the "faint" quality of most stinkhorns. The slime containing the odor is inside the five rays and oozes through the spaces between them as they spread slightly The "eggs" are in clusters of three or four or more, and are about 3.5-4 centimeters in diameter A section of an "egg" shows the conspicuous cap enclosed by the thin white inner wall, while the stem is much compressed until the elongation begins which pushes the cap rapidly into the air

According to Mr C G Lloyd, whose publications on this group have furnished some of the illustrations here used, the branched stinkhorn may have been introduced from Australia or South America, where species occur that greatly resemble it. Both in Europe and in the United States it seems to have appeared rather recently in gardens fields and other cultivated places. Dr Peck found it in an asparagus bed, while it was collected last October at the New York Botanical Garden in a gladiolus bed Several collections have been made in Massachusetts and Connecticut in tomato and potato fields, and one in a lawn newly plowed and seeded Professor Beardslee found an acre of it in Ohio, where heavy sod had been turned and allowed to decay It had not been seen there before and its sudden appearance in such profusion was rather difficult to explain

The Last Word in Power Houses

(Continued from page 98)

and into the main channel of the river before any of it reaches the intake again By that time it is thoroughly cooled

The coal unloading tower also has points of interest. Here, also, the engineers faced the necessity of reducing weight in order to permit the use of concrete. A great deal of height and weight was eliminated in this instance by using a conveyor belt which carries the coal up an incline and distributes it to the bunkers within the plant. The fuel is lifted from the barges by means of a crane hoist of standard design and dropped into a magnetic separator From there it passes into the crusher and thence to the belt.

In all large generating stations, the electric currents and voltages are of such magnitude, and the necessity of centralized control is so imperative it would be impractical to operate the switches by hand For these reasons they are equipped with electric motors which open and close them and which are all controlled from a central control switchboard located in the operating room

The pipe room, referred to above as a special feature of the electrical equipment, gets its name from the fact that it is the terminus of all the iron pipe conduits through which the wires from the central control switchboard are led out to the small motors on the high voltage switches. Through other pipes terminating in this room also pass the wires leading to the instruments which are mounted on an instrument board located in the central operating room directly in back of the control switch board, and which tell the operator at a glance what his machines are producing and to what substations the energy is being transmitted

The layman hearing this room described and seeing it is surprised that no one ever thought of it before In conception, the idea is simplicity itself

In plants where no such room is provided the pipes are terminated in a trough depressed in the floor of the operating room in back of the switch boards. This means that there is a great mass of wires in the trough, which increases the difficulty of tracing faults in the wiring and in the event of one wire burning out, the fire may easily be transmitted to the wires controlling other circuits, resulting in interruptions to service and delay in restoring it, all of which is fatal to the interests of the power company

The Philadelphia Electric Company while studying ways and means of eliminating these delays and fire risks and thus assuring the company's ideal of continuous service has substituted its pipe room for the trough back of the switch boards.

The pipes are arranged to come up out of the floor of the pipe room directly under the respective switchboard panel controlling the circuit to which they apply The wires of each circuit are separated from those of other circuits through out so that a fault developing in the control wiring of one circuit cannot be transmitted to that of any other circuit. For convenience in tracing defects in the wiring and in testing switch board instruments, each wire passes through a fuse or cut-out block mounted on a terminal board in the pipe room and labeled so that the electrician can identify each wire without delay

It is altogether probable that this system of arranging control wiring will become standard for large power houses throughout the country It was first installed by the Philadelphia Electric Company in its Chester Station, which transmits electrical energy to Philadelphia at 66 000 volts pressure over an aerial line on steel towers. This plant was completed in 1918, in which year it was considered the last word in the production of electricity It is equipped with two of the same size and type turbo-generators as those being installed in the Delaware Station

As indicated however, there have been several new developments in this station not to be found in any other power plants. The boilers are of the same type and rating as installed in the Chester plant. But in order to provide for the possible installation of oil-burning equipment if that should become necessary later, the boilers have been set higher than in normal practice when stokers are used, the tubes being fully twelve feet from the grates. This has resulted in an increase of efficiency in the combustion of gases particularly notable in coal containing a

large percentage of volatile matter, and during those periods when the boilers are being forced. An electric locomotive is used for the removal of ashes running directly under the discharge gates.

The new plant is in the center of one of the busiest and most congested industrial districts of Philadelphia, including in its range the great textile section known locally as Kensington and another district known as Richmond, given over largely to metal manufacturing plants. Power is supplied to these by underground cable at a potential of 13,200 volts and stepped down at substations for other industrial and for lighting requirements.

In common with all the other buildings of the company this structure when complete will present a most pleasing and stately architectural appearance. John T. Windrim, the architect, has put into it the kind of thought and effort that was confined a few years ago to memorial buildings and the like. This is in line with a definite policy of this company. It is based on the reasoning that the corporation is one of the city's biggest citizens and that it must do things in a big way.

Few persons realize the tremendous amount of work and equipment involved in the distribution of electric energy. For this one new plant there are being installed more than sixty miles of underground high voltage cable, 219 miles of single underground conduit and 1,200 miles of overhead lines. Each turbine in the plant is 48 feet long, 19 feet wide, 12 feet high and weighs 326 tons and each is equipped with a 50,000 square foot condenser containing thirty-six miles of tubing, requiring 37,500 gallons of water per minute for condensing 309,000 pounds of steam every hour. For cooling the generators eight thousand cubic feet of washed air is provided every minute.

The Heavens in August, 1921

(Continued from page 100)

At the beginning of the month they remain in sight until 9 P. M., but by its close they are almost lost in the sun's rays. Uranus is in Aquarius and comes to opposition on the last day of the month. At that time he is in R. A. 22h 38m 35s, declination 9° 27' south and is moving 9s east and 53" south every day. He may be found 2¼° west and 1½° south of the fourth magnitude star Lambda Aquarii, which is itself about one-third of the way from Beta Aquarii to Zeta Pegasi—these latter stars being marked on our map. Neptune is in conjunction with the sun on the 4th and is invisible.

The moon is new at 3 P. M. on the 3rd, in her first quarter at 0 A. M. on the 10th, full at 10 A. M. on the 18th and in her last quarter at 8 A. M. on the 26th. She is nearest the earth on the 3rd, farthest away on the 17th and at her nearest again on the 31st. During the month she passes near Mercury and Mars on the 2nd, Neptune on the 3rd, Jupiter and Saturn on the 6th, Uranus on the 19th, Venus on the 30th, and Neptune and Mars on the 31st.

Mount Wilson Observatory,
July 11, 1921.

A One-Piece Welded Structural Frame

(Continued from page 101)

more cheaply than either the screwed joint or the riveted or bolted joint. The matter of sanitation is simply one of trim construction that eliminates the ordinary recesses and surfaces for gathering and holding dirt.

The adaptation of tubing to structural work was first conceived to meet the difficulty of obtaining building material in the oil fields during the recent adverse conditions that prevailed in the Southwest and the first building erected was a comparatively small structure fabricated from odds and ends of pipe, of which there is always an abundant supply in the oil districts. The success of this experimental step led to the erection of a larger building, the steel structure shown in the accompanying illustrations. In this building 50 by 100 feet, all of the joints in the tubing were welded. The side, ends and roof are of corrugated iron and the floor of concrete. The trusses were separately tested by attaching a block and tackle to the bottom chords, one at a time, and hoisting a heavy motor truck clear of the ground.

The same company is now erecting a still larger building in Dallas. This structure will be 100 by 200 feet. The sides and ends will be of concrete 10 inches in thickness finished in marble; the roof will be sheathed with reinforced concrete slabs 2 inches thick; there will be a skylight 26 feet wide and two 2½ foot ventilator shafts, skylight and shafts extending the entire length of the building; the floor will be of concrete and there will be steel sash windows and roller doors. A large chain hoist will be swung to one of the trusses for the loading and unloading of heavy weights.

This will be the largest building of its type yet erected, but it is stated that it by no means indicates the limit of dimensions to which the new welded tubular construction may be advantageously adapted; that any number of stories and any size of floor space can be built in this way. The new departure will be observed with considerable interest in building and engineering circles.

Sodium Hypochlorite

THERE are signs that a new household bleaching, deodorizing and disinfecting agent is about to become popular in the United States. It is called sodium hypochlorite and is a close relative of chloride of lime, which contains calcium hypochlorite.

Sodium and calcium hypochlorites are very interesting compounds because they contain two active elements, oxygen and chlorine, either of which without the other forms inert stable compounds with the sodium or calcium; but when both are present in the proportions to form hypochlorites they act as two husbands of a single wife would if they were well matched in strength and little afraid of each other—they are both disgusted with this family arrangement and look for a chance to escape and enter into more attractive combinations. Usually it is the oxygen that escapes, but when acids are mixed with the hypochlorites the chlorine is driven out.

The oxygen in hypochlorites is loosely bound and very active. In the air oxygen is rather sluggish unless the temperature is raised to the point where ordinary combustion takes place. We use matches to reach this temperature. But the oxygen of the air can be made active at ordinary temperatures in another way. If sunlight and moisture are present, the energy of the sun tears apart the sluggish oxygen molecules and leaves the oxygen in an active form that will destroy germs, bleach colors and sweeten things that have foul smells. This is why we put linen on the grass in the sunlight and sprinkle it with water. The hypochlorites obtain their energy not from sunlight but from electricity. The firmly bound and sluggish chlorine in common salt is torn away and set free by electricity, and made to pass into a compound containing oxygen, such as soda or slaked lime, forming the hypochlorites.

Chloride of lime is a useful household deodorizer and antiseptic because it is very powerful and quite cheap. It is used to sprinkle decaying vegetable and animal matter. It is put into ponds to disinfect them, which it does in such extreme dilutions as not to make the water unfit to drink, and when it is mixed with a weak acid solution such as urine or vinegar it generates chlorine enough to sweeten the air of a room without being strong enough to irritate the lungs and throat. But for bleaching [illegible] to take the place of sunlight [illegible] ture, chloride of lime is not well suited because it hardens water and prevents the detergent action of soap. For this purpose the sodium hypochlorite is better as it does not prevent the [illegible] soap. It has been used for many years in the households of France for bleaching the wash and for whitening and sweetening wood floors and wood sinks.

Sodium hypochlorite will not remove all stains. There are some colors that are too fast to be destroyed by it, and this is really an advantage as it permits its use for bleaching the white part of printed calicoes and other partly colored cotton goods. The claims on the bottles of some makes of hypochlorite are in excess of its destructive power on colors.

A canvas tent left out in the air, moisture and sunlight for some years becomes rotten from the action of the oxygen of the air in excess. So too, if sodium hypochlorite is allowed to act too long on wash, or in too great concentration it will weaken the strength of the fabric, but if it is used with discretion according to the directions on the bottle, both as to strength and time, it will do more conveniently what air, sunshine and moisture do: bleach, sweeten and sterilize cotton and linen without destroying the fiber.

Sodium hypochlorite was used in the war to keep wounds aseptic, and it may find a use for this purpose as a household aseptic. It is used in laundries, and is now being introduced for family use under many names, being easily identified by the peculiar and not disagreeable smell, which one soon learns to associate with cleanliness and purity. It is not a poisonous antiseptic like carbolic acid, corrosive sublimate and formaldehyde, unless it is mixed with large amounts of strong mineral acids, when chlorine is set free in such amounts as to be dangerous to breathe. Next to soap and washing soda, sodium hypochlorite may quite possibly become the most commonly used household cleansing reagent.

Comparative Value of Timber Cut from Live and Dead Trees

PREJUDICE exists in certain quarters against the use of timber cut from dead trees, and some purchase specifications insist that only timber cut from live trees will be acceptable. As a matter of fact when sound dead trees are sawed into lumber and the weathered or charred outside is cut away, there is no method known to the Forest Products Laboratory by which the lumber can be distinguished from that cut from live trees, except that the lumber from dead trees may be partly seasoned when sawed.

All the information available at the laboratory indicates that timber cut from insect or fire killed trees is just as good for any structural purpose as that cut from live trees of similar quality, providing the wood has not been subsequently injured by decay or further insect attack. If a tree stands on the stump too long after it is killed, the sapwood is likely to become decayed or badly infested by wood-boring insects, and in time the heartwood also will be similarly affected. The same thing is true of logs cut from live trees and not properly cared for. Until the wood becomes affected by these destructive agents, dead tree wood should be just as strong and just as durable as sound live tree wood.

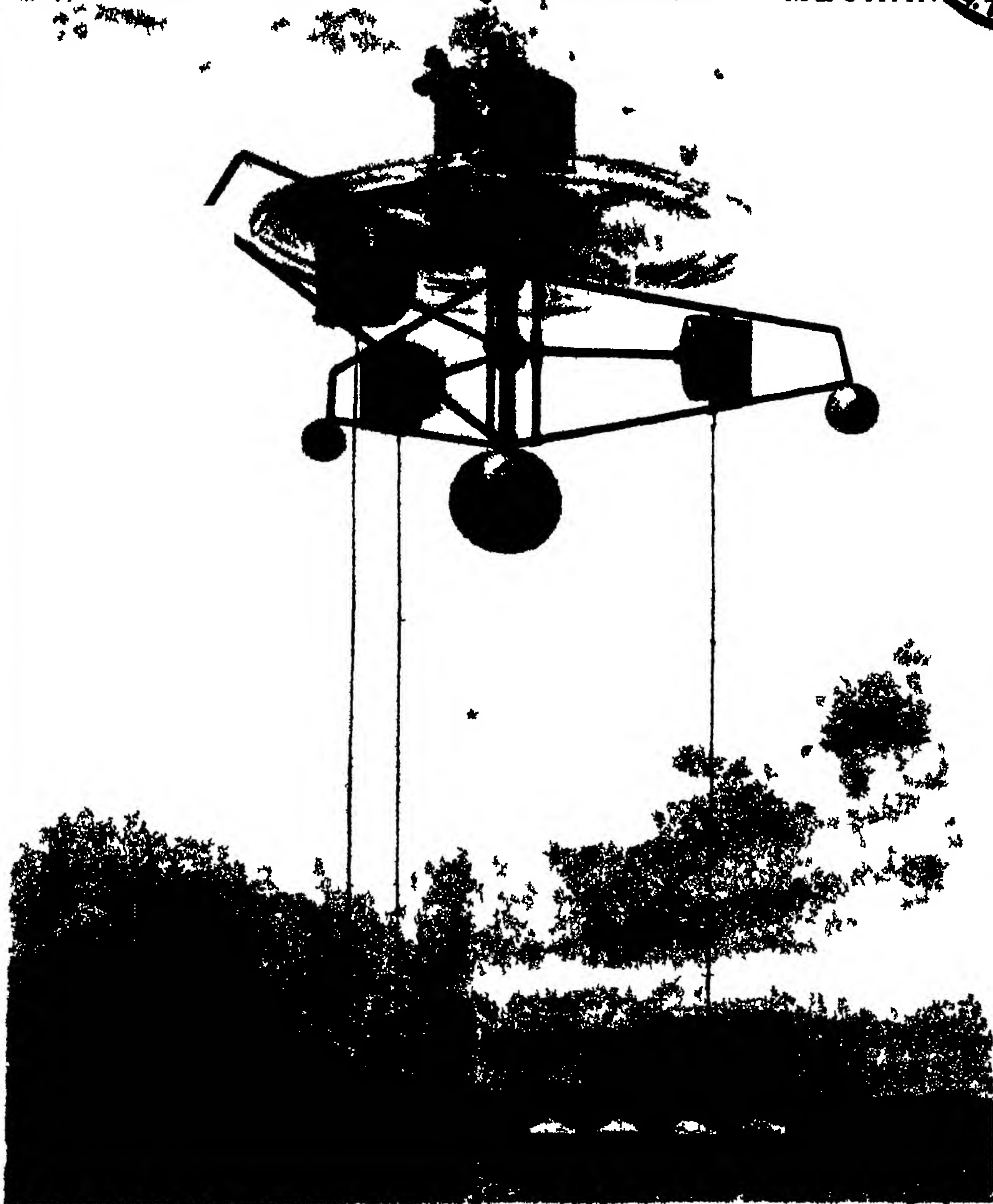
In considering the subject it may be useful to remember that the heartwood of a living tree is entirely dead, and in the sapwood only a comparatively few cells are living. Most of the wood [illegible] trees is dead, therefore, regardless of whether the tree itself is living or not. Such being the case, purchase specifications [illegible]

IN THIS ISSUE: **PROPOSED HUDSON RIVER PONTOON BRIDGE**
STARVING IN THE MIDST OF PLENTY

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY SCIENCE INVENTION MECHANICS



ASCENDING TO A HEIGHT OF 120 FEET IN THE PETROCZY CAPTIVE HELICOPTER. (See page [illegible])

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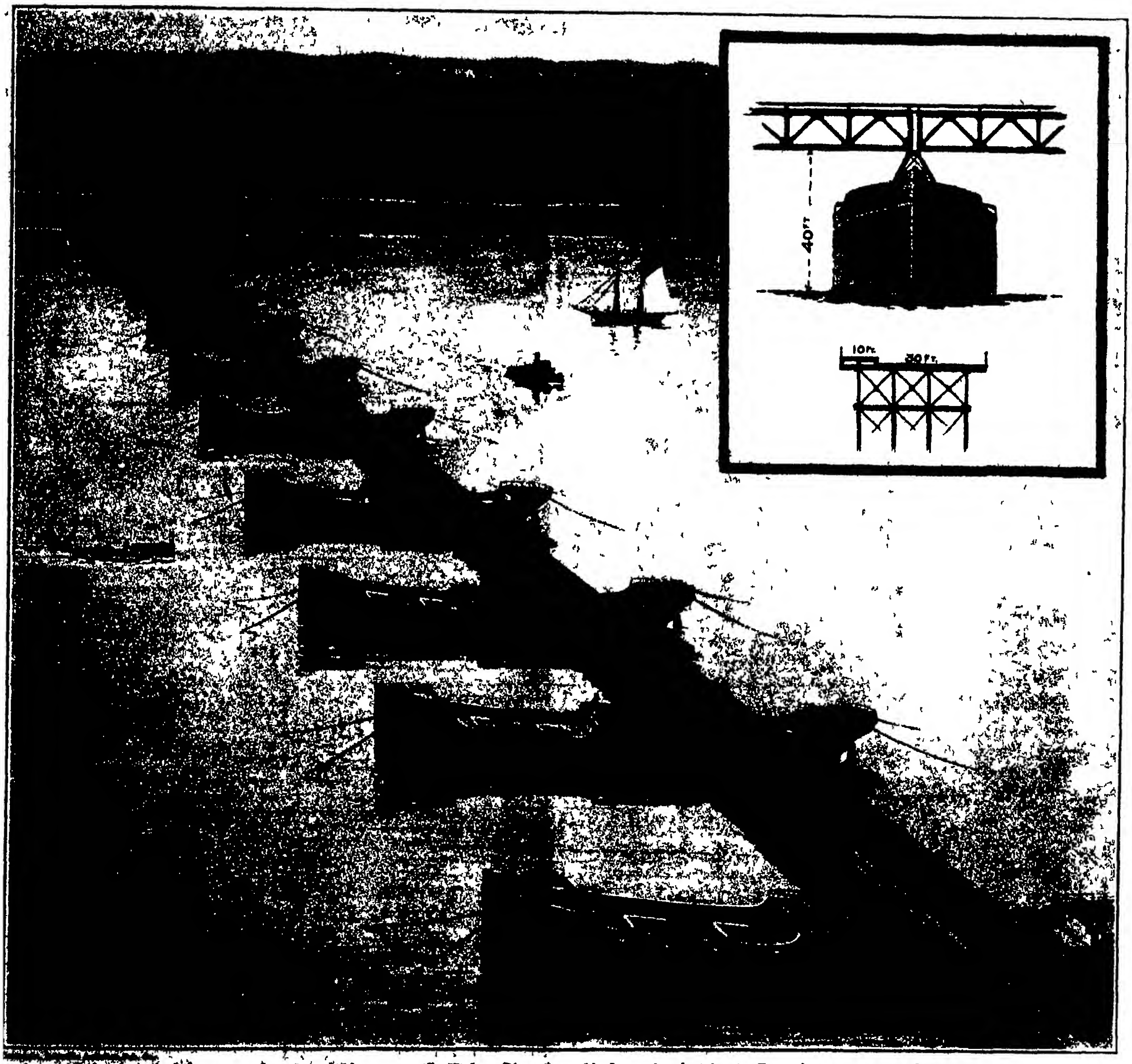

General view of the proposed pontoon bridge across the Hudson River for vehicular and pedestrian traffic, and a cross-sectional view of one of the ship units—[See page 117]

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The Hudson River Pontoon Bridge

THE proposal to build an emergency pontoon bridge across the Hudson River, as illustrated elsewhere in this issue is entirely feasible As a means of crossing straits and rivers the pontoon bridge was not only one of the very earliest and most widely used types of bridge, but for particular purposes and to meet special conditions, it has held its own for over 2000 years and is today in widely extended use Every schoolboy is familiar with the feat of Xerxes who built a double bridge across the Hellespont, one span being carried on 300 and the other on 314 vessels, anchored up and down stream He will remember, also, how Darius, in his war against the Scythians, used the same device to get across the Bosporus and the Danube as did the celebrated Ten Thousand when they crossed the Tigris in their retreat from Persia For military operations, pontoon bridges have held their own down to the present time, and the pontoon section forms today a most important branch of the engineering force that accompanies every modern army

The service which this type of bridge has rendered in military operations is matched by its usefulness in linking together the highway systems of the world Former visitors to Constantinople will remember the famous bridge of boats between that city and Stamboul, and every tourist who has made the trip up or down the Rhine has passed through the floating swing bridges in the center of the great pontoon structures which span that river at such places as Cologne and Coblenz Since the armistice several military pontoon bridges have been thrown across the Rhine in order to facilitate the movements of the various Armies of Occupation between the right and left banks of the river

There are two questions to be answered in considering this startling proposition to bridge the Hudson at a point where it is over a mile in width and these are first, is there any emergency call for such a bridge? and secondly, is it practicable? Answer to the first question is to be found in the present intolerably crowded conditions of automobile traffic at the ferries which afford the only means of vehicular communication across the Hudson At any time of the day there is an irritating wait to get across, and at certain hours there is a wait which means a very considerable loss of time out of a business day It is on Saturdays, Sundays and holidays, however, that the congestion reaches proportions which are unbelievable except by those who have had the misfortune to be caught in it Frequently the line of waiting cars will be backed up for several miles along the roads leading to the ferries and on a recent holiday, after waiting many hours on the western side of the river, New York and Long Island owners, in despair, actually abandoned their cars for the time being

As to the feasibility of the bridge there can be no question whatever The Ferris wooden ships, obtained from the Shipping Board, are vessels of over 3000 tons, and when they are moored to heavy anchorages up and down the stream, and the mooring cables drawn taut they will afford a foundation for the trusses, so secure, both vertically and laterally, that the bridge will have a stability which will compare favorably with a permanent structure A ship of over 3000 tons will be practically unaffected by such small waves as disturb the surface of the Hudson River The steelwork for the towers and trusses can be built within 90 days and since the boats are immediately available, it is estimated by Mr Lindenthal that, if there are no legal delays, the bridge can be opened to the public by the end of May, 1922. It should be noted that were it not for the fact that the boats are immediately available at a nominal cost, it would not be possible to entertain the idea of building a bridge of this magnitude, for the proposed structure will be by far the largest of its kind ever constructed But with the boats available and because of the standard shapes of which the towers and the trusses will be built, both the time and cost of the erection of the bridge will be reduced to a minimum

Inventing a Crime

CIVILIZATION in the beginning was a simple thing There was no elaborate machinery of government, of industry, of daily life And with everything else, right and wrong were of the simplest A member of this primitive society could take his neighbor's life by force he could take his neighbor's property by force beyond that there was little that he could do to wrong him There were accordingly few laws, and these simple ones, applying merely to what we recognize as natural crimes It was not even necessary to define the crime, the law was merely for the purpose of defining the penalty Thou shalt not kill, thou shalt not steal, thou shalt not covet thy neighbor's wife—that would cover the ground thou shalt not bear false witness was a later development And it was always easy to determine whether a particular offense had been committed

With the growing complexity of civilization it became possible to wrong a man in more ways, and in more devious ways It became possible, without actually using force or doing anything recognizable as an outright natural crime, to come out of a transaction in possession of another's property and without having given any fair return therefor As trade and commerce and government developed in complexity bribery and conspiracy came into existence and opened the way to an immense variety of operations whereby one might defraud a man of what was rightfully his At a comparatively early stage in the world's history it became feasible to proceed against a man's property or person in such a way that proof of the wrong done should be more and more difficult to present, while even definition of the crime committed might turn out to be considerable of a puzzle

The net result of all this is a sort of race between the offender and the law We have continually the invention of new ways of getting the best of the other fellow—we might say, with our heading, the invention of new crimes but that they are not crimes until the law making power has had its innings and made them so Conspiracy in restraint of trade, extortion of a rental out of all proportion to the value of the premises—these are among the less disreputable examples Sharp practice though they be, they are defended eloquently by many more or less sincere gentlemen, but in the public interest they are defined as crimes and the penalty fixed It then is the move of the sharpster again, and he develops a new procedure for getting his fingers into his neighbor's pocket-book So the game goes on, endlessly

As a rule it seems that the crook and the sharpster are a little ahead of the law This is entirely natural The law must necessarily follow the transgressor rather than lead him The law makers cannot meet together and allow their imaginations to run wild in picturing all the devices that might be conceived by a clever crook for the purpose of relieving the individual or the community of superfluous cash, they can at most only provide for the known and established ways of doing wrong. The field must necessarily be left open for the ingenious transgressor to devise ways of achieving his ends that have not as yet been specifically prohibited The way must necessarily be left free for him to teach us these artifices by putting them into execution—only after we have had such tuition can we expect our law-makers to move the barrier so that it shall include the latest procedure among the things forbidden.

A case in point is furnished by the Chicago baseball scandal. We have no doubt that on numerous occasions disgruntled ball players have failed to exert their efforts to win, or have actually done what they could to betray their club. But concerted throwing of ball games for money, if we are to credit the testimony offered in this case, has been put on a business basis never before attained A new crime has been invented; and the legislatures of numerous states have responded by defining the offense and the punishment. But it appears that, if the inventor of a crime cannot get a patent to reward his ingenuity, he at least has the consolation that his practice of this crime will go unpunished, where a subsequent imitator lays himself open to the law that has been enacted as a result of his predecessor's activity

The World's Merchant Marine

IN the midst of the uncertainty which beclouds the immediate future of shipping, there is a certain measure of satisfaction in having the exact figures before one, showing just how much shipping there is in the world today, and what is its distribution These facts are to be found in the new edition of *Lloyd's Register*, in which the usual details are given of the seagoing vessels of all the maritime nations, including ships from 100 tons up to the 56,000-ton transatlantic liners

The world's total of shipping today is made up of 33,296 vessels of 61,974,653 gross tons. Before proceeding to consider the larger totals, it should be noted that the gradual reduction in sailing tonnage continues, although the increase in this type of vessel which has occurred in this country has tended to slow down somewhat the general *decrease* It is a curious fact, which will be news to many of us, that over 40 per cent of the sailing ships of the world are owned in this country The decline is shown in the following figures In 1902 about 22 per cent of the world's tonnage consisted of sailing ships, in 1914 the percentage had decreased to 8 per cent and in 1921 to 5 per cent. The increase in wooden vessels from 1 per cent of the total steam tonnage in 1914 to nearly 4 per cent in 1921 is to be attributed, of course, mainly to our own construction of wooden steam vessels to meet the emergencies of the war

In spite of the large amount of German tonnage which was allocated to British owners and the huge program of new construction which has been under way since the armistice, the total tonnage of the United Kingdom in 1921 is only 411,000 tons more than it was in 1914 Here is an impressive evidence of the terrific inroads made on British shipping by the wear and tear of the war and by German submarine attacks. On the other hand, the seagoing tonnage of this country has seen during the same period an increase of about 10,400,000 tons, an advance of not far from 600 per cent on the total for 1914. This, of course, gives us a strong position in the second place among the great maritime nations.

Conversely, although Germany in 1914 stood next to the United Kingdom with a total of over 5 million tons of seagoing shipping, her merchant marine today includes only 654,000 tons of shipping

In the matter of relative standing, as shown by a comparison of 1914 and 1921, the percentage of the world's seagoing steam tonnage owned by the United Kingdom has fallen from 44½ per cent to about 35½ per cent The United States' percentage has risen from 4.3 per cent to 22.7 per cent Japan now stands in the third position, with France a close fourth Norway, formerly in the third place, has now, largely by reason of the depredations of the submarine fallen back to the sixth position

A strongly accentuated development in shipping is seen in the growth both in numbers and tonnage, and in individual size, of steamers for the carriage of oil in bulk In 1914 the total number of steamers engaged in this service was 385, whose total tonnage was 1,479,000. Today, according to *Lloyd's Register*, there are 861 oil carriers driven by steam or motor, with a total of 4,419,000 tons. That is an increase of 200 per cent in seven years Of these vessels 55 are from 8000 to 10,000 tons, and 37 are over 10,000 tons in measurement.

Another notable development has been the use of oil for propulsion either under the boilers or in heavy oil engines. Oil-burning steamers have increased from 364, of 1,310,000 tons in 1914, to 2536, of 12,797,000 tons. Unquestionably, if the supplies remain fairly constant, oil is destined to displace coal in the merchant marine, except for special ships, or in lines of service where the routing and supply conditions are favorable to coal

Naval and Merchant Marine

A 4000-Pound Demolition Bomb.—According to Army Ordnance, the progress in the size of bombs continues at a rapid rate. Illustrations are given of the new 2000-pound bomb, of the kind which sank the "Ostfriesland" in the tests described in these columns last week, and of a 4000-pound bomb. The 2000-pound bomb is a little over 13½ feet long, about 19 inches in diameter, and carries 1000 pounds of explosive. The 4000-pound bomb, 19½ feet long and about 23 inches in diameter, carries one ton of explosive.

German Ships Will Be Up-To-Date.—German surrendered tonnage will not be a loss to the ship owners, since the Government will give them about 12 million marks for the rebuilding of their fleets, and the new ships will be built in German yards. According to the *Shipping World*, the Treaty has overstocked the harbors of the Allies with shipping, much of which is old in design. Consequently, a few years from now, when the Germans have made good progress in reconstruction and possess ships of the most modern type, the surrendered vessels will be obsolescent, and the disadvantage under which it was expected that German pre-war shipping would labor will perhaps be converted into actual advantage.

Engineers Investigate Panama Canal. — A new board has been appointed to investigate the operation of the Panama Canal and determine how to make the Canal Zone more efficient and less expensive as a Government concern. It is in line with modern thought that the Secretary of War should have recognized that the engineering profession is particularly well qualified for this work. He has appointed to the Commission three engineers, and a representative from the allied public utility field. It stands to reason that these men will make a more understanding survey than would be possible in the case of the politician to whom such a task is frequently assigned.

Sixteen-Inch Coast-Defense Gun.—In the shop tests of the new 16-inch barbette carriage for coast defense, recently completed at the Watertown Arsenal, the carriage functioned very satisfactorily. The load required on the slow motion hand wheel to traverse the piece was 17 pounds. It took 27 minutes, using man power, to elevate the gun from 0 degrees to 60 degrees. The electric traversing and elevating equipment had not as yet been assembled. One of the most difficult problems in designing the carriage was the control of the gun which, with its recoil band, weighs about 200 tons. The gun will have an all-round fire and will throw a 2340-pound armor piercing projectile to an extreme range of 55,000 yards. It can penetrate 14 inches of armor or more at all ranges up to its maximum.

Shipping Board Finances. — According to the new Chairman of the United States Shipping Board, there are outstanding claims against the Board of about $420,000,000, and there is a working deficit each month of about $21,000,000. This means that until conditions improve and unless they improve, the country must pay out an annual subsidy of nearly 250 millions of dollars to keep things going. As matters stand the nation is called upon to make a choice between three conditions: either the ships must be sold for what they will bring in the open market, or we must make such revision of our shipping laws and such reorganization of the Shipping Board as will make them more efficient, or we must be content to subsidize our merchant marine to an extent which will maintain it as a going concern in the face of the fierce competition that exists among the world's sea-going carriers.

New Dock for the Port of London.—There was recently opened on the Thames, 6½ miles below London, in the general neighborhood of the Royal Albert Dock, a new dock which will accommodate vessels of up to 30,000 tons. The entrance lock is 800 feet by 100 feet, with 41 feet 8 inches over the sill at ordinary tides. The water area of the enclosed basin in which the lock opens is 64 acres, and the depth 38 feet. There are 10,000 feet of quay wall, capable of berthing 14 steamers of the largest size. The length of the dock is 4578 feet, and the width varies from 500 to 710 feet. Two lines of railway are laid along the quay, next to these are 3300 feet of two-deck sheds, and at the rear of the sheds are three lines of railway—an arrangement which should greatly facilitate the complex business of interchange between ship, car and truck. The piers and sheds are served by 24 electric level-luffing cranes, and each shed is further equipped with eight electric cranes of one ton capacity each. As a final touch there is immediately adjoining the basin a new dry-dock 750 feet long, 100 feet wide and 35 feet deep on the blocks.

Science

Glass and Tin Churns.—A patent was granted in England in 1851 for a cylindrical glass churn and these were tested at the Exhibition of 1851 in competition with French tin churns, and the old English wooden churns. The small wooden family churn worked so well that it was awarded a prize medal over its more aristocratic glass relations.

A Large Gift to Science.—Baron Edmond de Rothschild, member of the French Institute, has announced to the Academie des Sciences his intention to devote the sum of 10,000,000 francs to the foundation of a laboratory of scientific research. The announcement is accompanied by the request that the Academie will nominate two of its members to the administrative council of the proposed institute, which will be chiefly devoted to the development of physical and chemical science and its application to industry and agriculture.

The U. S. Pharmacopaeia for China. — The U. S. pharmacopeia is being translated into the Chinese language under the direction of the Philadelphia College of Pharmacy and Science. Before the war the many tried to have the German pharmacopeia translated into Chinese with the object, of course, that German manufacturers might export to China drugs of German standards. Great Britain has made similar attempts since the war, but our own standards are to be adopted.

Machine for Raised Embroidery.—The United States Consul at Lyons reports the invention of a machine at that place for the making of raised embroidery in gold and silver. It is stated that the stitch is a copy of an ancient form of embroidery and gives an impression of handwork, and is also the first machine that has been successful in using the metallic thread. Various machines have been employed in the making of raised embroidery in other threads. It is stated that the machine is the result of seven years of study and that the results are very satisfactory.

Three Thousand Dollars An Inch for a Shower. — An official of a Wisconsin organization telegraphed to a Canadian rain maker offering $3000 an inch for a precipitation. This organization represents 3500 Wisconsin farmers. This same Canadian rain maker on one occasion made $8000 for 4.24 inches fall. It is said that his rain making equipment consists of a tank 20 feet high in which a chemical mixture is prepared which he says "opens up the clouds." Of course little stock in such plans or devices is taken by the scientific meteorologists.

The High Swiss Fares Vex Tourists. — The Swiss railways are most admirable and the conditions are ideal for the tourists but unfortunately for them fares have been raised to such a point that very few of the tourists travel first class and many of them do not travel at all on the railroads, electing to go by automobile over the magnificent roads with which Switzerland is traversed. Where parties travel together the automobile effects a real economy and it is even cheaper for persons traveling between Italy and Switzerland to cross one of the passes by automobile than to use either the Gotthard or Simplon tunnels.

Tear Gas for Riots.—A test has recently been made in Philadelphia of tear gas as a means of quelling and dispelling a mob. The test was entirely successful and six policemen from Philadelphia were able to rout 200 of their stalwart companions. The movies have already demonstrated how banks and safe deposit vaults can be protected by gases placed in tubes behind the vault doors. An excellent point about the gas is that it leaves a reddish brown stain upon the clothing which would aid in identifying those taking part in riots or crime. Those who inhale the fumes become helpless for a time but the effects soon wear off. The underworld has already put in an order for masks to foil the police tear gas.

Misleading Accident Statistics. — One of the most prominent New York papers, always noted for its accuracy, recently stated that there were 11,000,000 persons killed and maimed by accidents for a year. This would certainly be a very serious situation if true, but as a matter of fact, in the entire registration area in Continental United States there were only 1,096,436 deaths from all causes, and in the same registration area in 1919 there were 61,266 deaths from accidental deaths. Dr. Crum, an expert statistician, gives the figures of accidental deaths in Continental United States in 1919 as 75,546, using the usual method of computing population. The statement first quoted is on a par with many other statements relating to safety. The National Safety Council and the Safety Institute of America are in a position to give authoritative figures when necessary.

Aeronautics

A New Use for Airplanes.—It is reported that airplanes are doing useful and most unusual work in France in dealing with the plague of grasshoppers on the Crau Plateau (north west of Marseilles) which is far more serious than it was last year, crops of all kinds being destroyed over some 100,000 acres. Pilots report breeding grounds and scatter poisoned bran.

A Worth-While Flight.—For some reason a really fine flight has been allowed to go by with little or no mention in the daily press. It appears that an Ansaldo plane of Italian manufacture recently flew from Mineola, Long Island, to Chicago, in 7½ hours, flying time. It was piloted by Lloyd Bertaud and carried three passengers and 500 pounds of express matter for the American Railway Express Company.

French Prize for Helicopters. — The French Aero Club has decided to offer a prize of 25,000 francs for the first helicopter that shall prove its power to rise direct from the ground in a theoretical cylinder to a height of 25 meters and return direct to the spot from which it started. The rules of the tests are to be drawn up by the Aviation Commission of the Aero Club.

Rivers as Airways.—Just so long as we lack suitable airways and airdromes, it appears that the safest practice is to follow our leading waterways such as rivers, canals, lakes, coast lines, and so on, using seaplanes for the purpose. In this manner a pilot can always make a relatively safe landing, as compared with the airplane pilot flying over rough country devoid of landing fields. A number of rivers and other waterways have been surveyed with this object in mind.

Information for Aviators. — On November 1st last the Hydrographic Office began the publication of *Notice to Aviators* which will be issued monthly if sufficient interest is shown and sufficient information is available. Information from aviators and parties interested is expected to return for this service. The publication contains such items as data on landing fields, weather reports, specifications for landing fields and so on. Persons desiring *Notice to Aviators* should address Hydrographic Office, Navy Department, Washington, D. C.

How Safe Is Commercial Flying? — The manufacturers Aircraft Association have recently completely an aviation survey of the United States, which sheds interesting light on the safety of commercial aviation. It is said that in the past six months the 1,200 commercial planes in operation in this country had flown approximately 3,250,000 miles. In these three and a quarter million miles of travel, only 15 persons were killed and 43 injured, in a total of 27 serious accidents. Most of these accidents occurred among that class of civilian aviators known as gypsy fliers.

The Oehmichen Helicopter, so we learn from our European contemporaries, has made a number of successful flights. This machine, it will be recalled from the description and photographs recently appearing in these columns, consists of a gas bag and a suspended framework which carries two huge horizontal air screws. The gas bag, we now understand, is employed only during the present tests and eventually will be eliminated when pilots become sufficiently familiar with helicopter flight. In the seventy sixth flight this helicopter flew 75 yards against the wind.

McCook Field's Big Engine.—The Engineering Division at McCook Field has completed the preliminary design of a 1,000-horsepower 18-cylinder engine, so we learn from *Aviation*. The design has been developed on the basis of 1,000 horsepower at 1400 r.p.m. direct drive, this speed insuring great reliability and being favorable to high propeller efficiency in connection with a large power output. The cylinders are designed to accommodate four spark plugs per cylinder, which has some advantage from the point of view of power output and economy. Furthermore, it is planned to use four independent magnetos, thus securing the utmost reliability through the use of four independent ignition systems.

Flight of Man-Driven Plane. — At last something definite has been done with "aviettes"—those funtastic combinations of bicycle, wings, and even air screws, which are supposed to fly but generally don't. We learn from newspaper reports that Gabriel Poulain, the French champion cyclist, succeeded on July 9th last in the Bois de Boulogne in winning the Peugeot prize of 10,000 francs for a flight of more than ten meters distance and one meter high in a man-driven airplane. Four times he flew over the required distance, his longest flight being over 12 meters. His machine is a bicycle equipped with planes the angle of which can be varied. The present success of this aviette is said to have been due to changing the angle of incidence in the rear wing.

Railroading Under Roof

Where the Severity of the Weather Practically Makes Transportation an Indoor Game

By Charles Frederick Carter

A graphic demonstration of why they have snowsheds at Blue Cañon, Cal.

OPERATION of the Southern Pacific Railroad over the Sierras on the Ogden Route between Sparks, Nev., 537 miles west of Ogden, and Roseville, Cal., 139 miles farther west, presents difficulties, to overcome which, expedients in construction maintenance, equipment and operation have been evolved that together constitute a bit of railroading spectacular enough to impress even the unsophisticated. Briefly summarized, these difficulties include the operation of a single track railroad having grades ranging from 79.2 to 125.14 feet to the mile and curves up to 10 degrees radius, on which train movements average one in each 21 minutes of the 24 hours exclusive of the movements of helper engines, and in a region where the annual snowfall sometimes amounts to more than 65 feet and averages two-thirds of that amount. In order to cope with this extraordinary precipitation the company is obliged to maintain 30 miles of snowsheds in a distance of 41 miles, 29 miles of the sheds being concentrated in 30 miles of line. While snowsheds are not rare on mountain roads nothing approaching so great a mileage of railroad under roof is to be found anywhere else in the world.

The snow is concentrated in a period of three months. It is very wet and heavy and as there is little wind it lies where it falls. Very little goes off during the winter. It keeps settling until the average depth on the level is 15 feet, though a depth of 26 feet has been measured many times. This makes the snow very heavy with streaks of ice in it. Slides are frequent and disastrous.

These conditions call for two types of sheds one to keep the snow off the track and the other both to keep the snowfall off the tracks and also to convey slides safely over. Both must be very heavily constructed, for they are designed to sustain a load of 300 pounds to the square foot. These sheds contain 100,000,000 feet of timber, which lasts an average of 26 to 30 years so that renewals are constantly going on at the rate of about a mile a year.

So great a mass of dry timber constitutes an unusual fire hazard. Instances are recorded of fires being started by the explosion of a carboy of acid, carelessly loaded in a way car contrary to the rules, and by a sliver from a red hot brake shoe. Members of the I. W. W. and other vagrants have also started fires, but the principal danger is from brush fires started by careless automobile tourists.

To guard against this danger a unique fire department has been developed. A few miles back from the line west of the summit stands Red Mountain, an isolated peak, 7860 feet high. On the top of this peak an observatory has been established in which two men are constantly on duty. As the summit is more than 800 feet higher than the highest part of the line the observers can see all of the 29 miles except two short sections hidden by spurs. An engineer's transit to which is attached a pointer traveling over a chart is mounted in the observatory. By training the transit on a suspicious smoke the pointer indicates on the chart the exact location. The observers do not wait to see whether a fire is in the sheds or in the brush, but telephone immediately to the fire stations. In addition carefully trained men patrol inside the sheds day and night, reporting from boxes stationed something less than a mile apart.

Telescopic section of double-track snowshed at a siding

Four fire trains, consisting of a locomotive with a fire pump mounted on the boiler, two water cars each with 12,000 gallons of water and a crew of four men, are stationed in a distance of 41 miles. In tests they have moved within 1½ minutes after receiving an alarm and they can go 40 miles an hour. Any point in the sheds can be reached by two fire trains within 15 minutes. To prevent fires getting beyond control and destroying the entire shed system telescopic sections are spaced about 6000 feet apart, though it is planned ultimately to space these 1000 feet apart. These telescopic sections are 96 feet long and mounted on car wheels rolling on rails at the sides of the shed. A locomotive is hitched to them and they are hauled into the adjacent shed for the summer when the fire hazard is greatest.

Chief interest in this roofed-in railroad lies in its operation, for in the sheds ordinary methods cannot be applied.

Even the locomotives are of a remarkable type to be seen nowhere else. Officially they are designated as "Mallet Moguls," and "Mallet Consolidations," the name being derived from the wheel arrangement, which is that of a Mogul or a Consolidation doubled up. But to the railroad men they are known as "Wompuses." The Mogul Wompuses which are assigned to passenger service have cylinders 25 and 38 by 28 inches, drivers 63 inches in diameter, weigh 390,000 pounds and develop 74,200 pounds tractive power. Consolidation Wompuses, designed for freight service, have cylinders 26 and 40 by 30 inches, drivers 57 inches in diameter, weigh 425,000 pounds and develop 94,880 pounds tractive power. The chief peculiarity of the Wompus is that it runs backward, the cab being placed foremost in order that the low visibility in the snowsheds may not be further obscured by smoke. The tender, with a capacity of 10,000 gallons of water and 3600 gallons of fuel oil, is coupled to the smoke-box end. The stack has a deflector to turn the exhaust horizontally.

From Sparks, which is 4413 feet above the sea, to Truckee, 37 miles distant, there is a climb of 1406 feet. Here the real climb for west-bound trains begins. Soon after leaving Truckee the train enters the Coldstream development, a loop laid up one side of a narrow valley and back on the other side, a distance of 24,500 feet to gain a distance of 2000 feet. The western end of the loop enters the snowsheds. The average grade from Truckee to Summit, a distance of 15 miles, is 80 feet to the mile though the ascent is not uniform, the worst grade being 125.14 feet to the mile. At Summit the helpers are cut off, leaving the Wompus to hold the train down the hill alone.

A panoramic summer view of the Southern Pacific snowsheds near Cisco, Cal.

From Summit to Roseville the distance is 87 miles by the track although in an air line it is only 64 miles. In this distance the train drops from an altitude of 7018 feet to 163 feet above sea level, or a total descent of [illegible] feet, some of the grades being 120.98 feet to the mile. In this distance there is an aggregate of 11,21[illegible] degrees of curvature, some of the curves being 10 degrees "and over," according to the engineering department.

The train halts at Summit while brakes and air signals are tested. Then [illegible] retaining valves are turned up, and the [illegible]

(Continued on page [illegible])

Saving St. Paul's in London

By M. Macartney, F.S.A., Architect in Charge

SIR CHRISTOPHER WREN, if the statement in "*Parentalia*" is to be credited, considered the soil that supported the central tower of old St. Paul's to be sufficient to carry his proposed dome. The central tower of old St. Paul's was 50 feet square, and approximately 260 feet high, carrying a lead-covered spire thereon some 200 feet high. Any calculations that one can make at this stage as to the weight of the old tower and spire must be very rough indeed, but the weight of a Gothic structure of the kind is, as a rule, comparatively light, and it is probable that the soil was not loaded so heavily as by the supports of Wren's dome. The present dome weighs approximately 60,000 tons, which is carried by 8 main piers, the area of the foundation of each of which is approximately 1400 square feet. This gives a pressure on the soil of approximately 5½ tons per square foot. The foundations are based upon the same layer of clay, or so-called "pot earth," as that upon which the old cathedral was founded. This clay should be able safely to withstand the load, though in planning a new building today, one would not probably put a pressure of more than 3 to 4 tons a foot thereon, in order to avoid undue compression and settlement. The area of the Cathedral is adequately drained, but there is water in the sand beneath the layer of pot earth about 13 feet below, which keeps the clay damp. Since the building was completed there are no special signs of settlement of the foundations, and certainly no movements have been noticed since close observation has been given to the matter in the last quarter of a century. The water level in the subsoil seems to remain fairly constant, and so long as it is not completely drained the clay will probably retain its present consistency. To underpin the foundations down to the London clay some 24 feet below would be a very difficult enterprise and extremely costly, and would hardly be warranted.

Next to the quality of the foundations comes the construction of the piers. It seems strange that Sir Christopher Wren, after severely criticising the methods of the mediæval architects, should have adopted a similar system, that is, a facing of wrought stone filled with rubble in lime mortar. The natural result followed, that is, the core of rubble and lime contracted as it dried and was compressed by the increasing weight of the superstructure of the building, thus throwing an undue stress upon the casing. I may here interpolate the remark that for many years the book "*Parentalia*" has been regarded as an authoritative source of information about Wren and St. Paul's. It was published by Stephen Wren in 1750, and contains a picturesque account of his grandfather's works, founded on material by his father Christopher Wren, the younger son of the great Sir Christopher.

When one is able to test the accuracy of this work, however, it is generally found to be untrustworthy, so much so that unless a statement is corroborated by collateral evidence it cannot be accepted as true. Therefore, the assertion that the settlement of the southwest pier was due to the unequal temper of the soil may or may not be the fact, especially when we find from the accounts that a considerable amount of

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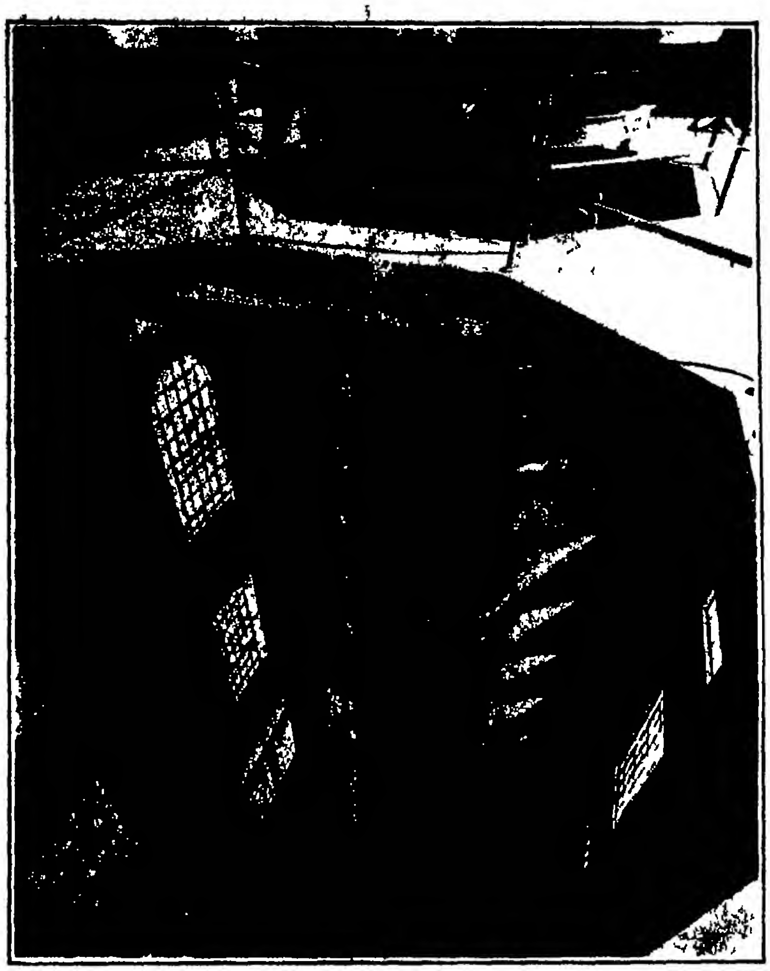


One of the gigantic cylindrical screens that keep the river debris out of the water used in Louisville's power station, raised and being cleaned

Clean Water for the Power Plant

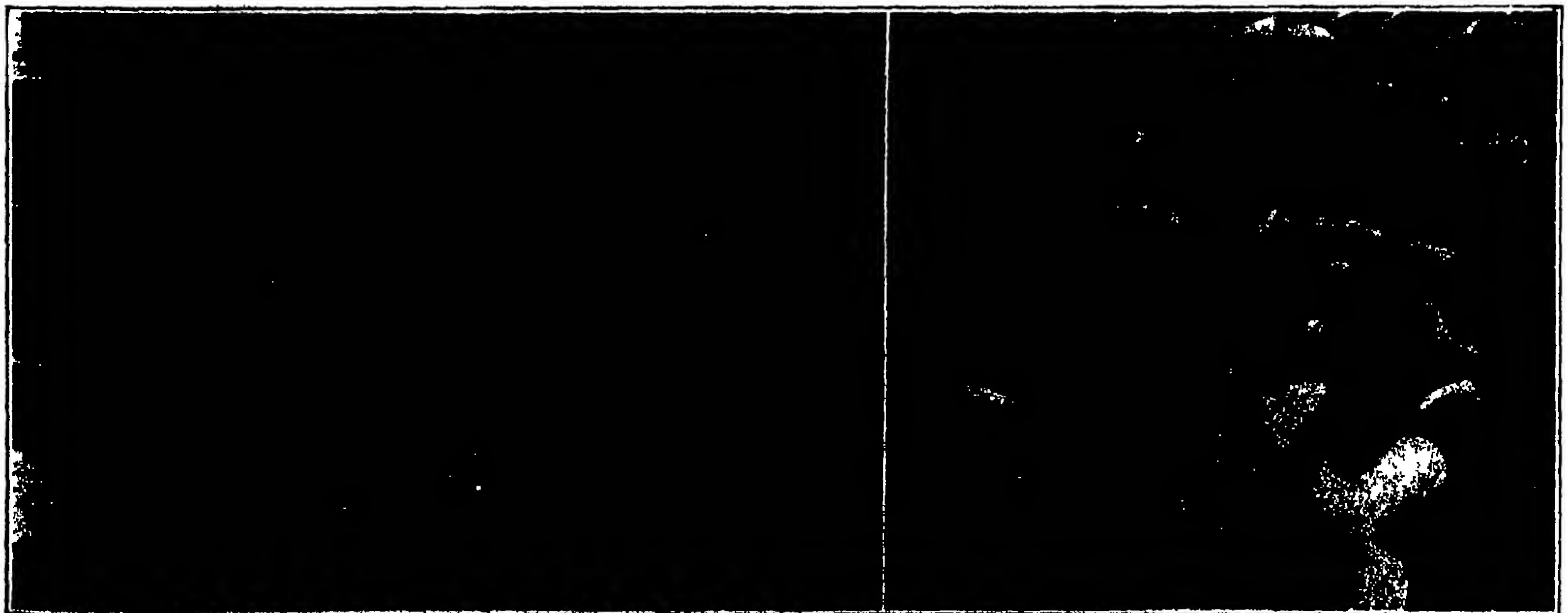
By George T. Holmes

LEAVES and twigs that float in rivers and lakes have created a problem that has long puzzled engineers of gas and electric generating stations in our inland cities. This débris although apparently insignificant in size is able to clog up almost any sort of screen now in use in such plants for straining the river water used in the turbines and condensers. Until recently the only sort of screening device has been a vertical screen or set of screens, but with these it has become practically impossible to raise the screens for cleaning in the face of the pressure of the water against the lower section of the screens, which gets clogged into a solid wall of mud and leaves.

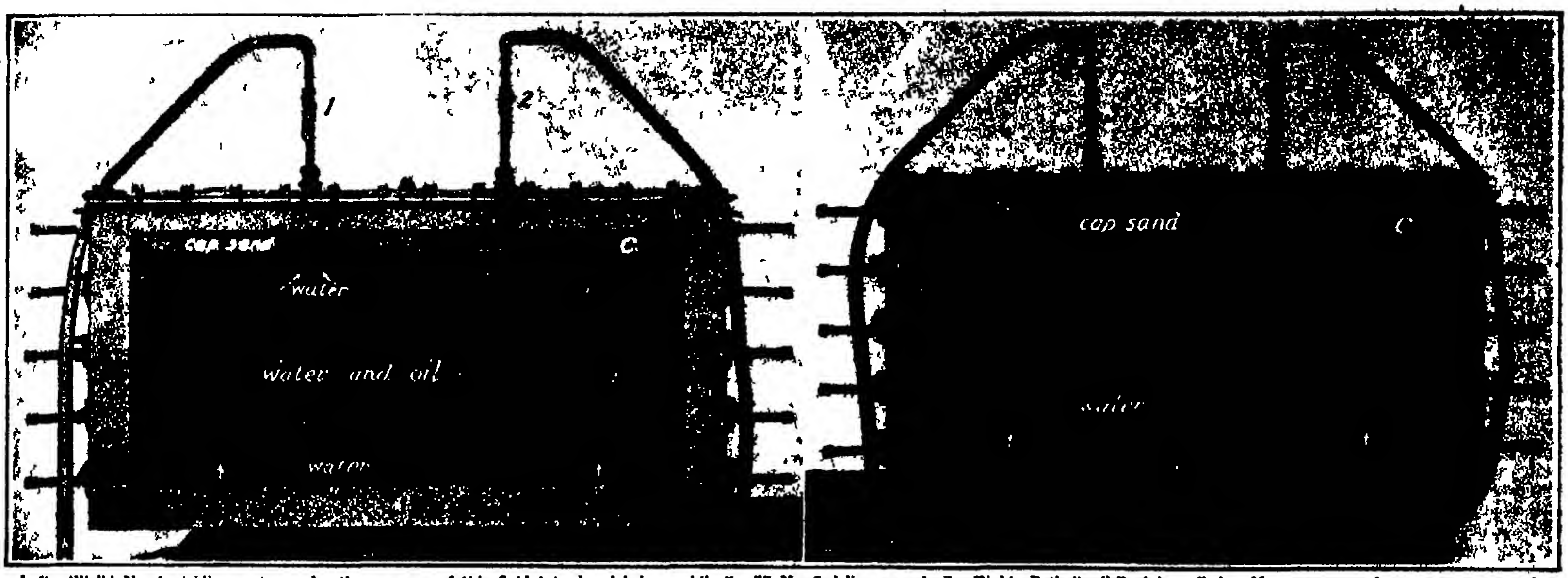
Engineers of the Louisville lighting company have discovered a better method than the vertical screen process and point out its beneficial results to other engineers confronting the same problem. The device is a duplicate set of three concentric cylindrical screens sixty feet high and about ten feet in diameter. Each set is capable of supplying sufficient water to run the plant, but the duplicate was installed a few months ago to have ready for use in case of any possible mishap. The screens are raised in a tower 120 feet high and cleaned one at a time. While one screen is in the air the water is strained through the other two so that at no time are there less than two screens in use.

Conditions at Louisville probably are typical of those prevailing at most of the towns which take condensing water from inland streams. The river rises and falls through about forty feet. The Ohio drains a water shed which becomes covered with leaves, weeds, etc. every fall. This rubbish does not come down regularly or gradually, but comes with the freshets and unless screening equipment is ample and designed for ready cleaning it will become foul and fail to pass sufficient water. To make matters worse the clogging of the screens causes them to act as dams, lowering the water on one side and keeping it up on the other, so that the pressure against the screens the flat kind being in use, frequently makes it impossible to move them, necessitating often a complete closing down.

The equipment now in use in Louisville consists essentially of three cylinders of wire netting, set concentric in a deep well. The water comes up through the floor which carries the screens, into the center of the smallest screen. It flows outward through all three screens, which can be raised and lowered separately for cleaning purposes.



Repairing old St. Paul's Church in London. *Left:* Making the preliminary examination of the structure. *Right:* Pouring liquid cement into a crack



Left: 'Well' No. 1 yielding water under the pressure of this fluid introduced below, while "well" No. 2 delivers good oil. *Right:* Both "wells" giving oil, but No. 4 on a much more generous scale because of the gas being pumped into the sands beneath it

Two laboratory experiments on miniature oil sands, which go to show why one of two nearby wells may produce while the other yields nothing but water

Getting the Rest of the Oil

Laboratory Tests That Reveal the Underground Secrets of the Petroleum Field

By Robert G. Skerrett

THE problem of a sufficiency of petroleum for the near future has more than once of late perturbed both Government and private technicists, and with reason Most of us are aware that liquid fuel is rapidly supplanting coal in many directions, and because of the greater efficiency of crude oil and its derivatives as a source of energy we, as well as the rest of the progressive nations, are profoundly modifying our engineering practices Accordingly, it is growing more essential to our industrial and commercial well-being that we continue to have an ample supply of petroleum at our disposal

Last year our consumption of crude oil totalled 531,180,000 barrels Up to date we have withdrawn from our underground pools 40 per cent of their contents, so it is estimated and at the present rate it is plain that it would not take us more than fifteen years to exhaust the 6,720,000 000 barrels of oil still remaining in our subterranean sands—*provided we could achieve a one hundred per cent recovery* But the outlook is even more disquieting, for we are authoritatively informed that the prevailing methods of mining the oil leave quite 50 per cent of it far down in the earth when the pumps cease to be effective

Manifestly, it behooves us to better materially the ways and means by which we work our oil fields, and some of the best minds of the country are concentrated upon the subject The experts of the U S Bureau of Mines have considered this economic problem from numerous angles, and latterly there has been evolved through the collaboration of several of these men an apparatus that is likely to prove of the greatest aid in utilizing nature's forces below ground so as to promote a fuller withdrawal of the petroleum stored there in the ages gone

Heretofore, little has been published and few investigations have been made regarding the ultimate amount of oil which a property might be expected to yield, and the rate of the output has been a matter of mere conjecture The producer gave scarcely any thought to such considerations—his main aim being to obtain as quickly as possible as much of the petroleum as he could from his wells. For a goodly period virgin territory remained available for exploitation, but these promising areas are dwindling fast, and because of this situation the American oil industry has come to an era that compels a more scientific and a more conservative procedure Success in this departure will depend upon a broader grasp of subsurface conditions and their interrelations.

Experience has revealed to the trained oil technologist that gravitation and the pressures exerted by neighboring volumes of gas and bodies of water, in connection with the make-up of associate geological formations, determine how petroleum will migrate toward or away from a well when the dome or pool has been pierced by the exploratory drill But until recently the exact reactions provoked were debatable and the theorists were by no means in complete accord Today thanks to ingenious laboratory apparatus that have been devised, various mute questions have been settled and much has been brought to light that can be applied to advantage in working any prescribed oil bearing area

As has been aptly said, there are two sets of influences which may regulate the productivity of a well—these are natural and artificial Those of nature's making are the oil content of the reservoir rock or sand, the resistance to the movement of the oil through the materials holding it, the expulsive forces available, and the degree of effectiveness of these forces in driving the oil from its resting place The chief artificial factors are the manner of operating the wells, the way they are spaced in relation to one another, and the application of processes to stimulate the subterranean transition of the oil for the purpose of bringing it within the reach of the recovering apparatus.

And then, by way of adding to the complexity of the problem, the actual amount of oil that may be carried in a "pay streak" depends upon the thickness, the porosity, the extent, and, not infrequently, the degree of saturation of the sand. Further, the quantity of oil that can be extracted by the operator may hinge upon the viscosity of the petroleum and the size of the sand grains lying in its course. The natural expulsive energy is that developed by the dissolved and the associated compressed gases, the direct pressure exerted by contiguous water, and the action of gravity Gravitational migration, as understood in this connection, is the effort of the lighter oil to surmount the heavier water—a change of position which may or may not facilitate the yield of a given well.

In order that these several variables may be brought into play at will and observed over suitable periods of time, Mr R Van A Mills of the U S Bureau of Mines has perfected a type of boxlike steel tank, provided with a heavy plate-glass front. Two sizes have been constructed for research work The smaller pattern is 36 22 inches long, 18.9 inches high, and 3.54 inches deep from front to back and the large tank is 72 24 inches from end to end, 48.82 inches from top to bottom, and 5.24 inches through. The small tank has a capacity equal to 10 40 gallons, while the larger design has a capacity of 79 04 gallons. The thickness of the face plates, which are removable, is contingent upon the pressures to be exerted within the apparatus during experiments. Either the cover plate or the heavy glass is taken off to arrange the materials for a test, and the character and the disposition of these are determined by the geological problem under consideration

At corresponding elevations on each end, at points along the bottom, and at two places on top, each tank is tapped and provided with valves and connections through which air, oil, and water can be admitted. The air is used to represent natural gas, and, like the water and oil, is introduced at any desired pressure. The two top connections simulate neighboring wells, and their juxtaposition makes it feasible to trace the influence of one upon the other under different operating circumstances. These taps enable the investigator to introduce fluids as he may wish and to cause them to travel either horizontally or vertically by opening outlet valves at appropriate points. Again, the facilities at his disposal are such that he can induce the currents to assume a jet-like flow and at predetermined velocities, or by the employment of suitable baffles, current movements can be prevented.

The auxiliary equipment includes tanks for oils, water, and gases, if such be needed, and a reservoir charged with compressed air There are, besides, meters of different sorts, gauges, thermometers and pressure regulators. A particularly interesting feature of this laboratory installation is the formation of artificial sandstone within a tank. This enables the scientist, by the employment of chemical reagents, to convert loose sand by cementation into a body approximating

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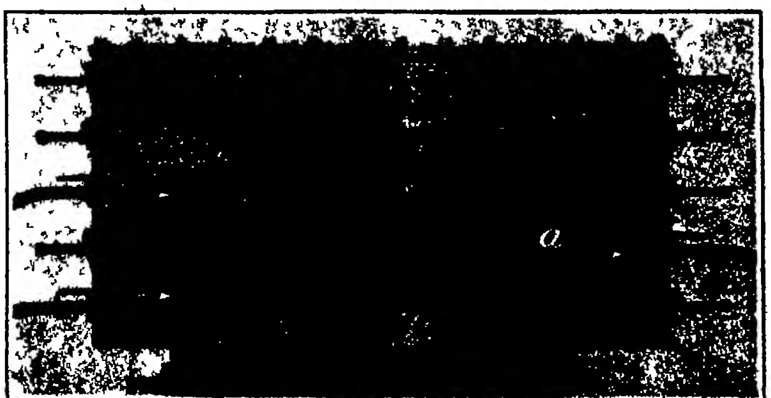
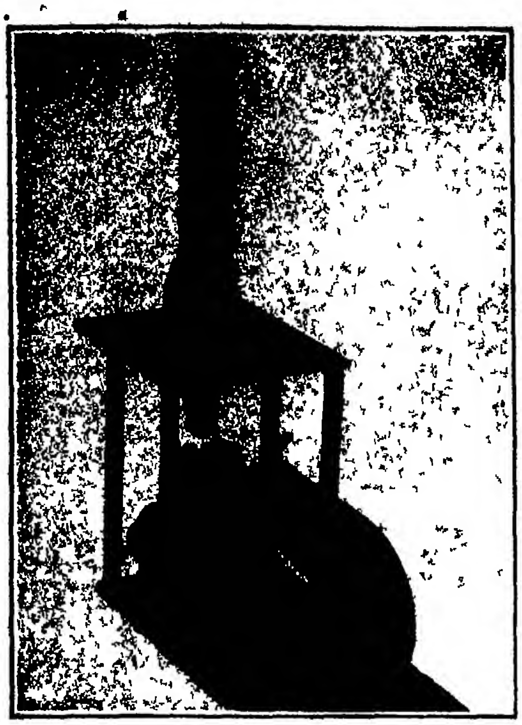


Example of the segregation of oil above water in a porous sand. The water, somewhat salt, was forced in from the left and allowed to drain off at the right



An extremely sensitive form of vibration galvanometer which is free from external tremblings

Making the Most of the Vibration Galvanometer

BEING portable, sturdy and free from external tremblings, a new form of vibration galvanometer designed by P G Agnew of the Bureau of Standards may establish itself as a serviceable instrument for industrial laboratories as well as prove valuable to central electric stations in testing transformers in the power house and afield The extreme sensitiveness of the prevailing types of vibration galvanometers has precluded the expansion of their uses

The recently built instrument is of the moving iron type as differentiated from the moving coil form of vibration galvanometer Essentially the device consists of a fine steel wire mounted on one pole of a permanent magnet, its arrangement permitting the free ends of the wire to vibrate between the poles of an electromagnet through which the current to be detected passes It operates under the principle that if an unmagnetized steel wire is held near the pole of an electromagnet, the end of the wire will vibrate with twice the frequency of the current.

If the wire be magnetized by mounting it on the pole of a permanent magnet, the free end of the wire will be alternately attracted and repelled by the magnet, that is, the wire will vibrate with the same frequency as that of the current. Of more importance, the alternating mechanical pull will be very much greater than with an unpolarized wire, because the total flux is much greater The permanent magnet plays the same role in increasing the motion of the wire that a similar magnet in a telephone receiver does in increasing the motion of the diaphragm

With a magnifying power of 50 to 100, satisfactory under working conditions, a motion of the vibrator of five microns is readily discernible With a 270-ohm winding the sensitivity is such that a current of 0 05 microampere can easily be detected The virtues of the new form of vibration galvanometer, according to the inventor, are its freedom from external vibration quick responsiveness, sturdiness and ease of adjustment.—By *S R. Winters*

A Detached Escapement for Clocks

MOST of us do not interest ourselves particularly in the intricate little mechanism which we wear on our wrists or in our pockets. To the average person the word "escapement" means nothing very definite The escapement however, is a most important element There are four main parts to a watch or clock the motive power which may be a weight or a spring the train of wheels, or "works," operated by the motive or driving power the agent for controlling the movements of the train—this part, in large clocks, is usually a pendulum, while in small clocks and watches it is a hair spring balance, and the escapement, that part of the mechanism by which the pendulum or balance wheel receives at each stroke the impulse necessary to keep it going at uniform pace, and overcome its tending to die out.

Monsieur Ch Fery, a professor at the School of Physics and Chemistry at Paris has invented a novel escapement which has proved to be most satisfactory and is a valuable contribution to horology A beautiful little clock designed by M Rodanet and equipped with this new detached escapement took first prize at the recent Perret competition We show here a photograph of the clock and a line-drawing depicting how M Fery's device works The escape wheel, *C* is mounted on the shaft of the last cog of the driving train As it turns, the split arm, A, pivoted at O lifts a lever provided with a counterbalance *M* which forces one end of the lever to rest on the screw, *V*, during the stops of the escape wheel on the other end is a rounded weight, *P* On the pendulum is another part *P* equal in weight and similar in form to *P'* which pushes the lever down in its horizontal passage At the moment when the pendulum rests on the end of the lever, the weight *M* is lifted the curved arm *I* touches the cog of the wheel, *b* and is pushed upward Once the pendulum has swung back the end of the lever *P*, lifts with the combined effort of the weight *M* and the pressure of the cog *b* and the other curved arm *A* coming in contact with the cog *a* is pushed upward In this way the pendulum is propelled but the force given it is controlled by the two curved arms and is independent of the weight *M* In this new escapement the vibrating system undergoes first a retarding action, then after its release it receives a much stronger accelerating impulse A close comparison of the movement of a pendulum governed by the usual detached escapement with one governed by the Fery escapement shows a greater amplitude, or length of oscillation or vibration for the Fery escapement M Fery's is a clever device —By *C M Lewis*

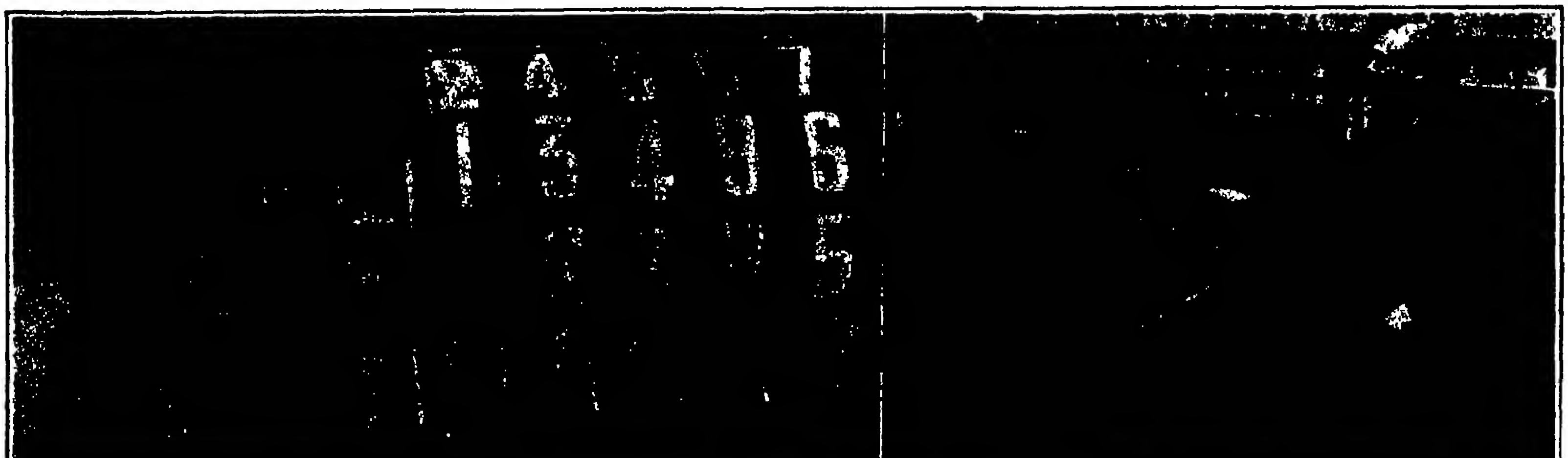
New form of escapement developed by a French professor and its principle of operation

Stock Quotations at the Mere Push of a Button

AN ingenious system of posting stock quotations has made its appearance on the Paris Bourse—the Wall Street of France By means of a push button keyboard an operator can post any stock quotations on the boards in plain view of the traders Obviously, this is a marked improvement over the usual manual method of posting quotations by means of cards or slides and it is more expeditious by a good margin

The French stock quotation indicator consists of a motor driven machine which carries five indicator wheels, on the periphery of each of which are stencilled the numerals from 0 to 9 with one space left blank The motor drives these wheels through suitable reduction gearing by means of an electromagnetic clutch

The principle of operation is simply to spin the five wheels and then by pressing certain push buttons to energize one electromagnet in each of the five batteries of electromagnets Each battery of electromagnets consists of eleven solenoids, mounted on the stationary frame of the device within its indicator wheels By means of an armature operated by the energized electromagnet each wheel is stopped at the desired point, so as to bring the desired numeral into position behind the window Each wheel carries a lug inside the rim, which engages with any one of the eleven electromagnetically operated armatures which acts as a stop The operation is quite rapid and positive —By *Ralph Howard*



Left: Mechanism of the electrically-operated stock-quotation board employed in the Paris Bourse, showing the electric motor, reduction gearing, and the five wheels which carry the numerals. Note the electromagnets mounted within the wheels but which are held on a stationary frame. These electromagnets operate armatures which, in turn, engage with a lug inside each wheel and bring it to a stop at the desired point. *Right:* Push-button board and the operator. These buttons serve to energize the necessary electromagnets of the stock-quotation board so as to post the necessary figures

The two ends of the electrical stock quotation board used on the Paris Bourse

Starving In the Midst of Plenty

Present Knowledge Regarding the Cause and Cure of Pellagra

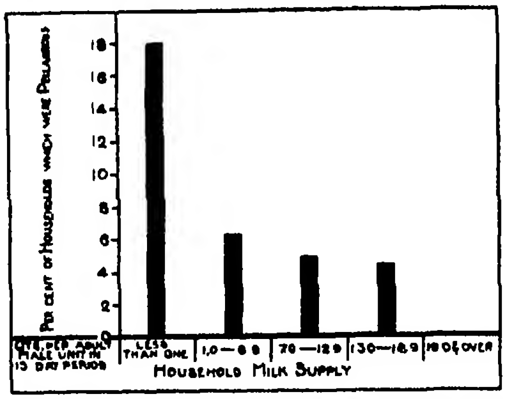
By Robert G. Skerrett

THE social and economic sacrifices entailed in the loss of 10,000 lives in the course of a single year are matters of profound moment. The U. S. Public Health Service has recently declared that pellagra will levy a mortality to this extent among the inhabitants of thirteen of our Southern States during the current twelve months. Indeed for a decade and more pellagra has stood out as one of the foremost causes of death in the region in question.

But this is not the whole of the story. It seems that probably 100,000 persons will be affected by the disease in 1921, and unless steps are taken to arrest the malady many more will be afflicted with it next year. Apart from the fatal cases we must recognize the financial and productive losses due to the sickness or the invalidism of tens of thousands of people.

Pellagra has been known to the medical fraternity since 1735 when it was first discovered in northern Spain. Two decades later the disease was identified in northern Italy, where it has been endemic ever since, and it appeared in southwestern France to a pronounced degree about 1820 during a period of extreme poverty following in the wake of the Napoleonic Wars. At that time the people at large subsisted as a rule upon a diet made up of cereals, fat pork and but a scanty allowance of fresh vegetables. In Italy for a long while, pellagra was ascribed to the continual eating of much maize, and the prevailing belief abroad fifteen or twenty years ago was that it was the consequence of eating spoiled corn porridge.

Pellagra was not observed in this country to any extent until about 1908, but its rapid increase in the South thereafter reasonably occasioned alarm and led to both State and Federal investigations. The work of the U. S. Public Health Service in this field of inquiry has been of a notable character, because the experts have established conclusively how pellagra can be cured as well as prevented. The problem resolves itself into a question of diet—one sufficiently diversified to contain a proper proportion of the food elements essential to satisfying all of the needs of a vigorous body. And once more it is made plain that we may eat enough of wholesome food to gratify the appetite and yet induce grave physical disturbances by reason of the unbalanced nature of the diet.

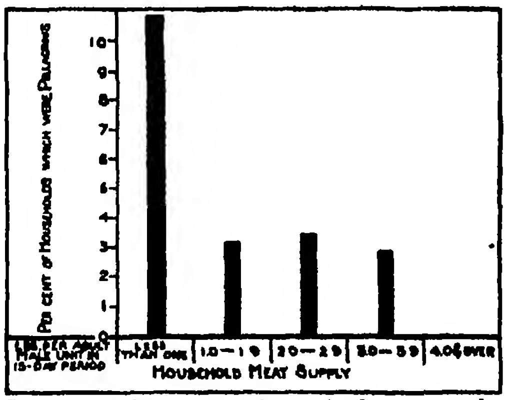


A further graphical demonstration, for the same villages, of the relation between milk supply and freedom from pellagra

The studies that were taken up by the U. S. Public Health Service in 1918 were centered principally in South Carolina and were finally brought to a focus in 1916 in seven cotton mill communities in that State. The researches were restricted to the families of the white portion of the population composed well nigh exclusively of native-born Anglo-Saxon stock. It was found that out of a total of 4399 persons the incidence rate of the disease was 42.7 per 1000. Repeated and systematic questioning of the dwellers in each household brought out the fact that pellagra was uniformly in evidence among those who subsisted mostly upon cornbread, biscuits made from white flour, grits, gravy, and syrup, and who consumed little if any lean meat or milk. They were relying on cereals, starches, and fat, and denying themselves foodstuffs rich in protein.

A short while before this intensive survey of the cotton mill villages, Dr. Joseph Goldberger and some of his fellows of the U. S. Public Health Service carried on a series of dietary experiments among the inmates of certain State institutions. At one of them eleven volunteers were fed during an interval of six months upon a restricted diet made up of bolted wheat flour and cornmeal of good quality, polished rice, sugar, pork fat, sweet potatoes, and relatively small quantities of cabbage, collards, and turnip greens. In the course of five months six of the subjects developed pellagrous symptoms. As will be seen, this diet was deficient in foods containing protein. Dr. E. V. McCollum, of Johns Hopkins University, has obtained similar results in feeding the same food to rats.

The cumulative evidence of the part played by a



Pellagra incidence in relation to fresh meat supply, as studied in seven cotton-mill villages of South Carolina

lack of protein in promoting pellagra was further emphasized when youthful patients from pellagrous households were given a properly rounded or balanced diet. These under nourished little ones were quickly cured by the corrected diet and, what is equally significant, they became stronger and better physically than they had been prior to developing the disease. For we are now very certain that sanitary circumstances are not connected with the incidence of pellagra as is the case with typhoid fever. Further, we are positively assured that pellagra is not a communicable disease. No one will have it if he eat foods containing the elements essential to all of the bodily functions.

The people of the South are the principal sufferers because of their dietary habit. It is well known that they partake much less of animal foods, such as lean meat and milk, than is usual in other sections of the country. One explanation of this is that the South generally does not raise much livestock and the dairy herds are notably undeveloped by comparison. Therefore, fresh meat and milk are rather high-priced commodities, and in the small towns and rural districts the supplies are somewhat limited. Naturally any economic disturbance makes it harder for the poorer citizenry to buy these foodstuffs. This is the situation today.

Nearly sixty years ago an eminent Frenchman made this observation regarding pellagra in the endemic area of southern France: "Shepherds are almost all pellagrous, cowherds are hardly ever such. They have the same occupation the same manner of life, but the cowherd nourishes himself in large part with milk." And milk, as we are informed, is rich in protein. Taking the nation by and large, the average daily consumption is half a pint of milk per capita. While the consumption per person in the favored parts of the country is considerably greater, in the South, however, the fresh milk supply in many communities is at the rate of little more than half a gill per individual! This state of affairs makes it easier to realize why pellagra has such a hold in the far-flung region lying to the south of the Ohio and the Potomac Rivers.

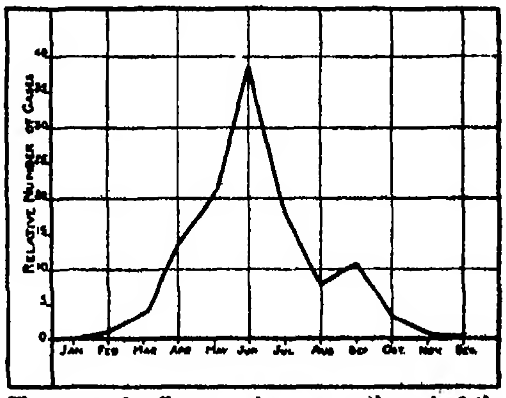
According to Dr. Goldberger, milk is the most important single food in balancing a diet and in preventing or curing pellagra. He tells us that if, for any reason, lean meat, fruits and green vegetables can be had only in very small quantities, then not less than 1½ pints of milk should be drunk daily. This may be in the form of fresh or buttermilk. However, if either of these be not available, preserved milk can be used instead, and during the experimental work in the cotton mill villages of South Carolina, one pound of canned milk was considered equivalent from a nutritive standpoint to one quart of fresh milk. This fact is of especial significance now in view of the relief measures which are likely to be undertaken shortly.

Lean meat, such as fowl, beef, pork, fish, etc., is of much help in balancing a diet in the absence of milk; and there should be provided quite half a pound of this foodstuff three or four times a week. This meat allowance may be reduced somewhat if the difference be made up by substituting eggs or cheese. Indeed, so we are authoritatively informed, the only cure that we have for pellagra today is a correct diet. And when this remedial agency is brought into play betterment of the patient is noted, even in severe cases, in the course of from ten to fourteen days! But recovery from an attack does not insure permanent relief unless a balanced diet be held to thereafter. Otherwise, there is apt to be a recurrence of the disease sooner or later.

Pellagra is seasonal insofar as the incidence of the disease reaches a maximum at the beginning of the summer. In the Southern States the malady attains its peak in the month of June, and as one of the accompanying graphs shows there is a steady drop in its prevalence from then on to the close of the year. This indicates, as has been brought out by our investigators, that during the winter and the early spring the victims live too much upon a pellagra-producing dietary. As a consequence, the disease reaches its climax just about the time that fresh vegetables and other produce of the farm begin to be plentiful.

It is found that pellagra is rare in children up to two years old—throughout that period in fact, when milk normally constitutes the chief source of nourishment. Among males and females the incidence is similar until they reach twenty, and in the case of the youthful the malady is more frequent between two and ten than between ten and nineteen years, inclusive. Clearly, the markedly formative period of childhood demands a full measure of protein, and milk rather than meat would seem best fitted to supply this need and the other dietary elements essential to body building. Among adults the incidence of pellagra is much higher in women than in men.

The most tell-tale characteristic of the disease is a distinctive eruption appearing simultaneously over the same area on both sides of the body. This may involve



The seasonal pellagra peak comes at the end of the winter and spring period of dependence upon stored foods

both elbows, both cheeks, both knees, etc. At first the eruption is not unlike sunburn, but later the affected skin assumes a parchment-like texture, then grows rough and scaly, and is likely to crack or peel. At the same time there are digestive and nervous disturbance. The sufferers lose strength, may become delirious, and when the disease is in an advanced or aggravated stage, the victim may collapse and die suddenly.

The effects of pellagra are cumulative, from year to year, in persons that return season after season to an unbalanced diet. Relief during the summer and fall months is deceptive, and each succeeding attack adds to the gravity of the physical condition and reduces the powers of resistance. The fundamental problem in dealing with pellagra is to bring about a widespread understanding of the necessity of a balanced diet at all times; and if this lesson be learned and applied we shall stamp out pellagra here just as was done decades back in France.

Proposed Hudson River Pontoon Bridge

An Emergency Measure to Meet Severe Automobile Congestion

THE pontoon bridge, in which boats or barges take the place of piers, is a form of construction which not only has the sanction of centuries behind it, but today it is used extensively for crossing important rivers in Europe. Notable instances of this are the pontoon bridges across the Rhine at Cologne and Coblenz.

It might be supposed that the obstriction to traffic would be very severe, but the Rhine bridges seem to have functioned satisfactorily, although that river carries, and has carried for many years, an exceedingly heavy traffic both by barge and steamer In the case of the Rhine bridges, provision is made for the passage of river traffic by hinging a section of the bridge so that one end of this section can be released and allowed to swing downstream. Means are provided for hauling the swinging bridge back into position after the shipping has passed through

It is now proposed to utilize the pontoon method of bridge building on a very extensive scale by a crossing of the Hudson River from Yonkers to Alpine The width from shore to shore is 5700 feet, and the length of the pontoon bridge between the trestle approaches will be about 4800 feet. Provision will be made for the passage of Hudson River steamers by building some form of drawbridge, probably of the lift type, across the main channel of the river There will be enough clearance between the water and the underside of the bridge to permit of the passage of river tows and the smaller craft, without opening the drawspan

How the Suggestion Originated

The proposal to build a pontoon bridge at this point came first from Major W A. Welch, Engineer of the Palisades Interstate Park Commission At present, because of the utterly inadequate facilities for getting across the river, the park is comparatively inaccessible to millions of New York City people The matter was suggested to the Major by the application of the Shipping Board for anchorage privileges, for idle wooden ships, in the Hudson River waters adjacent to the park Major Welch suggested the use of the ships for a pontoon bridge to Mr Otis H Cutler, who is Chairman of the Hudson River Bridge Corporation and he submitted the idea to Mr Gustav Lindenthal the designer of the Hudson River Bridge The undertaking was found to be entirely practical, in fact, Mr Lindenthal had proposed the construction of a pontoon bridge across the Delaware at Philadelphia to assist the movement of military supplies during the war This bridge would have been built but for the intervention of the armistice

The bridge at Yonkers will, of course, be an emergency bridge, built to give temporary relief to the unimaginable crowding of automobiles which is heavy on any day of the week and unbelievably bad (by those who have not witnessed it) on Sundays and holidays It is nothing unusual to find one's self on the western side of the river, or on the eastern side for that matter, with a string of automobiles *miles* in length between one's machine and the ferry, and a wait of several hours is a usual occurrence at these times The pontoon bridge, which Mr Lindenthal says can be built in less than a year, at a cost of two million dollars, will afford immediate relief a dozen miles to the north of New York City, and will ease up the crowding of the New York ferries very materially

Principal Dimensions of the Bridge

The plans call for a series of steel trusses 100 feet in length which will be carried by steel towers rising from the decks of the ships, which will thus take the part of the usual piers There will be four lines of trusses each ten feet in depth, upon which will be laid a wooden flooring with a total thickness of 12 inches The width out and out of the trusses will be 30 feet, and the width overall of the floor will be 40 feet. Thirty feet of this will provide a roadway sufficient for three lines of automobiles, and adjoining this will be a 10-foot sidewalk for foot passengers The steel towers or piers will be erected at the middle of the ship and each tower will consist of four braced bents with their posts battered in the direction of the axis of the bridge, the width being 20 feet where they rest upon the deck of the ship and three feet at the top, where they receive the ends of the steel spans

The Ship Pontoons

The wooden ships which will be taken over from the Shipping Board will be about 40 in number They are of what is known as the Ferris type, 281 6 feet in length by 45 2 feet broad When the bridge is completed, the underside of the trusses will be about 40 feet above the water The ships will be very securely anchored either by massive anchors sunk in the river bottom or by massed piling driven ahead and astern of the ships. It will readily be understood that because of the great size of the ships the secure manner in which they will be anchored, and the absence of any waves sufficient to cause any roll or scend of the ships, the bridge, to all intents and purposes, will be as rigid as one whose piers reached to the river bottom Furthermore, because of the length of the ships, it will be possible in the future to make a very quick and comparatively inexpensive addition to the capacity of the bridge by erecting additional towers and steel spans adjoining those at present proposed

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The Captive Helicopter

Details of the Remarkable Machine Developed by an Austrian Army Officer

SOME time ago we had something to say regarding the remarkable captive helicopter developed by Lt. Stefan von Petroczy of the Austrian Army Balloon Corps, which was built and tested during the war It has been our good fortune to obtain further data from British official sources regarding this captive helicopter which has made several flights, and we have had our artist prepare the present cover painting, using as a basis the rough sketches of the Petroczy helicopter which have come to our hands.

The first tests were made at the Austrian Airplane Factory, Ltd, Wiener-Neustadt, with propellers of rather large diameter The captive helicopter, fitted with gasoline engines, consisted of a three-armed frame made of steel tubes, in which three reconstructed Le Rhône engines of 120 horsepower each were mounted The engines drove two propeller shafts, revolving in opposite directions by means of a transmission gear, and these propeller shafts in turn drove two wooden propellers, each 20 feet in diameter, at about 600 revolutions per minute. Three petrol tanks were installed near the motors. The entire system was supported by a large buffer, which was kept tightly filled with air through an air-pump driven by the engines, under the end of each arm three small buffers were similarly disposed. The object of these buffers was to reduce the shock in abrupt landings. The observer's seat, made of veneer, was situated over the propellers and strongly secured to the stationary gear-case by the concave interior propeller shaft. A machine-gun turret was located on the upper rim of the observer's seat. A parachute was fixed beside the observer It had an area of 2800 square feet and was intended, in case of sudden stoppage of the motor, to bear the weight of the entire installation, including the observer. The parachute was to operate either automatically or under control Automatically the parachute operates in such wise that when a regulator adjusted for the purpose falls below a certain number of revolutions of the propeller it releases a mechanism which ejects the parachute. This ejection from the center causes the parachute to open instantly and tests have proved that it begins to work after a drop of about 80 feet. This device thus ensures the captive helicopter against damage in case the engines should stop at low altitudes The same mechanism brings the motor to a standstill at the time of ejecting the parachute The parachute may also be worked by hand by the observer, who is furthermore provided with a pack parachute for personal safety A need for the use of the parachute occurs only when at least two engines have stopped, two engines being capable of maintaining the propeller at a sufficiently high rate of revolution.

The climb takes place as follows When the observer has taken up his position, the engines are started and this creates no difficulty by reason of the fact that one engine at work causes the others to revolve The functioning of the motor can be controlled by the observer, and future types of the captive helicopter will have the necessary instruments located within reach of the observer As soon as the engine has attained the full number of revolutions, a signal will be given for the loosening of the winch and the machine will then, according to present experience, climb at a speed of about 4 feet per second This climbing speed mainly depends upon the pitch of the propeller and the direction of the wind, and it can, therefore, be considerably increased The captive helicopter is brought down by reversing the winch

Up to date, the engines have always run at full intake, in which case the excess of lift must be compensated. In future, the engines will be throttled in order to diminish the work of the winch The total weight of the captive helicopter, with engine and fuel for one hour, but not including the observer and the machine-gun, is about 2900 pounds. It is strongly constructed and some slight lessening of weight may yet be attained At the start the total weight lifted was about 4000 pounds, that is, about 11 pounds per horsepower This can be considerably augmented by enlarging the propellers. The original type of captive helicopter driven by gasoline engine power was manufactured by the firm of Dr Liptak Ltd Budapest Szentlörinez under the special supervision of Professor Karman's collaborator, Lt. Eng W Zurovec and the above-named firm owns their patent

The reports of the test flights undertaken may be summed up as follows

From April 2 to 5, lift and stability tests at low heights, duration tests up to 60 minutes.

From May 17 to June 10, climbing to from 30 feet to 100 feet altitude Results Lift excess on the ground to a load of 4 men Perfectly tranquil soaring at an altitude of 100 feet Wind velocity during tests up to 20 feet per second The general outline of this machine will be made clear by our cover, showing it in full flight. After about fifteen successful flight tests, the machine had a breakdown when landing on June 10 The power of the Le Rhône engines, which had been recently repaired, decreased so considerably that there was an insufficient excess of thrust, and the machine therefore oscillated violently, especially while being brought down The crew abandoned it, and the machine turned over on the ground, the propeller blades sticking into the earth Considering the state of the motors, Professor Karman and Lieutenant Zurovec had wished to omit the tests (there being a wind velocity of 20 feet per second), but they were urged to carry them on by the testing commission, as a result of which the machine was wrecked The results fully confirmed those already arrived at with model tests, so far as stability is concerned Observation made in the wind proved that in addition to the fundamental demand for ample excess of thrust, the position of the center of gravity of the machine in its relation to the plane of rotation of the propeller is of great importance. The results obtained in that respect, both in theory and by means of practical tests, should be of the utmost value as applied to the details of construction of a second type

Enemies of Timber Construction

Some of the Insects that Prey on Piles and Beams, and the Extent of Their Depredations

By J. F. Springer

OF all the forms of life which attack and destroy the integrity of timber construction, perhaps the *teredo* is entitled to the greatest notice. This little mollusc works below the water, most often perhaps at the mudline, entering a timber through a minute hole at an early age and then continuing his operations upon the interior. Because of the smallness and location of the entrance aperture and the damage done when beyond observation, teredos may accomplish a very extended and serious amount of damage before anything wrong is detected. Besides, only a few species of wood are proof against this activity. As submerged timbers, especially piles, are used as the foundation of many marine structures, it may be granted that the activity of the teredo may become dangerous as well as expensive. Just before the Great War—that is, in 1913—the Manati Sugar Company built a marine pier in the Bay of Manati on the north coast of Cuba. In five years, in the spring of 1918, part of the pier failed. In order to keep up sugar shipments, quick work had to be done by way of repairs. But after this, the pier was examined in what appeared to be good and undamaged parts. Certain piles had broken in two. They were found to be seriously honey-combed by some boring form of life, the principal damage being apparently in locations that had been in deep water and at or near the mud line. Eight piles were pulled which were thought to represent fairly the remaining stand of apparently good piles. All of them gave way, breaking at the mud line. Evidently, the whole pier had, so far as its foundation was concerned, gone to pot in five years. The piles were of Cuban hard wood. Undoubtedly, the teredo was responsible for this destruction. What has been illustrated by this case is representative of the depredations of this mollusc everywhere.

The teredo is familiarly known as the "ship worm." Once having entered a pile or other timber, the teredo is understood never to come out again. It follows the grain of the wood, as a general thing, and one teredo burrow hole never breaks into another. If, in the course of its burrowing activity, it comes too close to another burrow, it alters its course to pass. Great numbers may inhabit a single pile, and cut its interior in the infested zone to mere shreds of wood. Still the pile may stand and present the general appearance of soundness. The burrow may attain diameters up to ½ or ¾ inch in the higher parts. The hole is lined with shell. But, usually, a short length at the top is left uncoated. Sometimes, however, the lining covers the full length, the inner end then being hemispherical.

The head of the teredo lies in the inner end of the burrow. An adult may be only a few inches long or it may measure a yard. It depends on the particular species. There is a pair of shells at the head. These are triangular in outline and quite concave next the animal. Just how the boring takes place is apparently unknown. It has been conjectured that it results from operating the shells. Thus, the teredo has been thought to use a sucker-like foot at the head end as a means of fixing itself and then cut the woody fiber with a rasping action of the shells. Another opinion makes the boring action due to a solvent secreted from the surface of the teredo. Still another thought is that the teredo gets ahead in its burrow by means of silicious particles imbedded in the skin in front of the shells. But some scientists say that there are no silicious particles nor solvent acid secretion. One expert believes the foot already mentioned is the real boring tool. Another animal, the *pholas*, has been actually observed to bore with shells, a sucker foot being used as a support. Against this theory, in so far as the teredo is concerned, is the presence of an epidermis on the shells, which it is thought could hardly be present if they were used as rasps.

Experimental piles removed from California waters in 1913. The borers and their ilk have left little enough of the big sticks

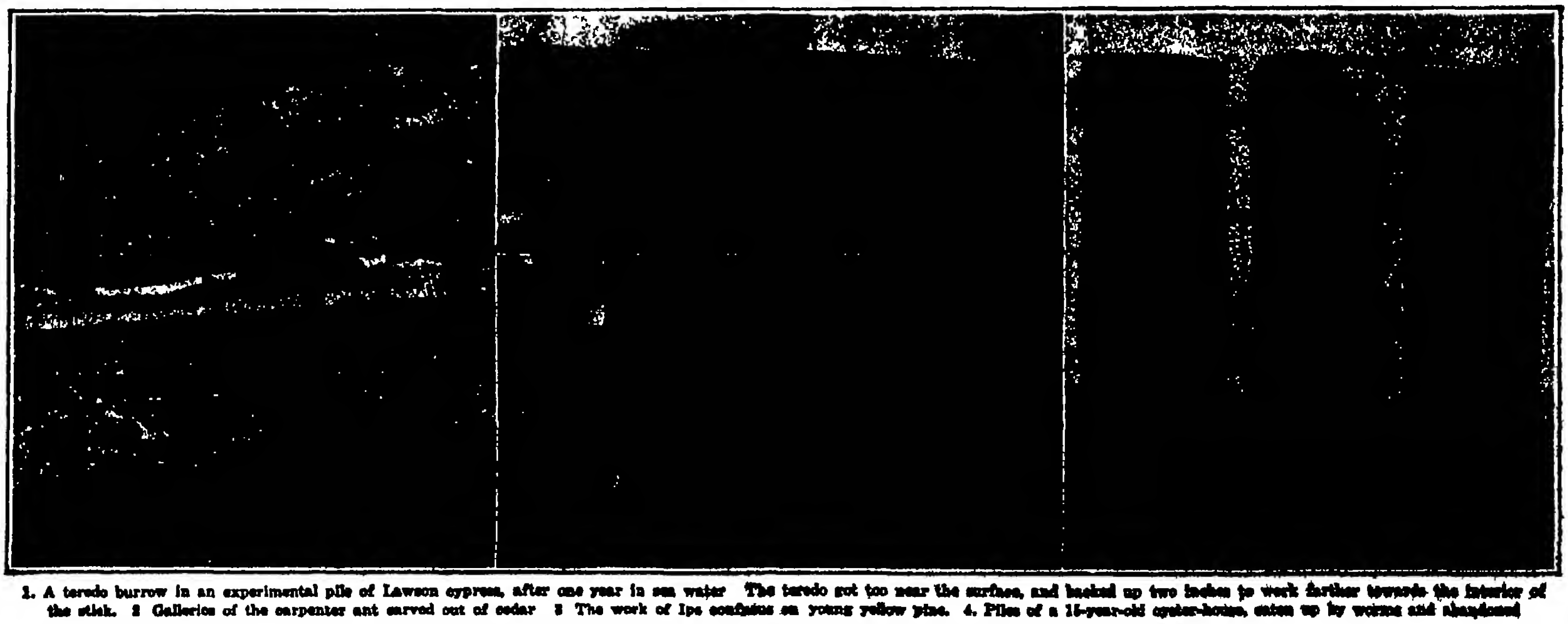
The teredo may operate with some rapidity. One of the older naturalists tells of a ferry-boat accidentally sunk in the spring and raised again after four months. The wood had already become useless. This was on a northern coast of Spain.

Some woods are believed to be proof against the teredo. Sneezewood, found in Natal, South Africa, is claimed as immune. It has been considerably used in marine work. Jarrah wood is also claimed as suited to marine construction on the ground that it resists better than any other wood the *teredo navalis* and other boring animals. When used on land in the tropics, this wood is said to be equally good as a resister of the white ant. It is found in the southwest of Australia, and nowhere else than in Australia. There is a good deal of it there and it grows to goodly sizes, sizes big enough to give a timber 2 x 2 feet in section and 40 feet long. It has the same specific gravity as water. However, it has the bad quality of breaking rather easily, there being a deficiency of fiber.

The teredo is, however, not the only marine boring animal. A very similar type is known by the name *xylotrya*. This is also a mollusc. The eggs are laid free in the water. These hatch to form swimming larvæ. They are at first free in the water and are said to attach themselves by a foot to a timber and then to bore their way in. The tubular holes are lined with calcareous material. The diameter of the hole is, on the average, about ⅜ inch, but it may run up to 1 inch. The length may be in the general neighborhood of 4½ inches, but a maximum of 12 inches or even more is sometimes attained. This little mollusc is so small when it enters that the perforation is like a pin hole. Inside, however, the diameter grows with that of the animal itself. The galleries are said to be closely intertwined and very numerous.

The *limnoria*, commonly known as the gribble, is a very small isopod. This animal is supposed to gnaw or bite its way into the pile or other submerged timber. The body is somewhat flat and there are numerous legs. The depredation consists of a hole 1/32 to 1/16 inch in diameter directed perpendicularly into the timber. The depth of the hole will be, say, ½ inch. Between adjacent holes, the partition left is quite thin, so that they pretty effectively destroy the wood to the depth of the penetration. The limnoria infests both the

(Continued on page 123)

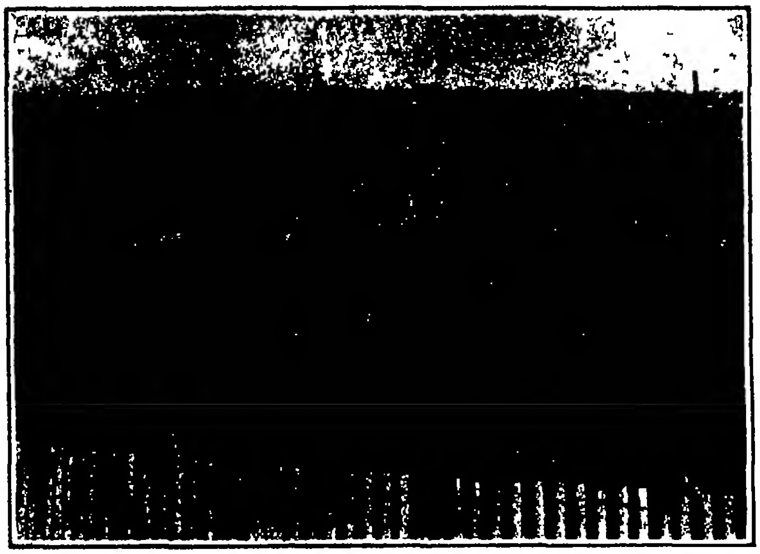


1. A teredo burrow in an experimental pile of Lawson cypress, after one year in sea water. The teredo got too near the surface, and backed up two inches to work farther towards the interior of the stick. 2. Galleries of the carpenter ant carved out of cedar. 3. The work of Ips confusus on young yellow pine. 4. Piles of a 15-year-old oyster-house, eaten up by worms and abandoned

The work of the teredo and other enemies of wood, both in water and on dry land

Idaho's Rabbit Drive

EVERYBODY has heard how the rabbit after he was deliberately introduced into Australia, multiplied to such an extent that within a comparatively few years he became a pest, and had to be put down at a cost of many millions. It appears that the irrigated districts of our own West are subject to the same trouble, though in this case they are innocent of having brought their own woes upon themselves. Readers of the early western classics will doubtless recall numerous authors who have repeated the yarn about walking across the prairie on the rabbits without ever stepping on the ground. The present picture gives some indication that this may not have been altogether an exaggeration. It comes from Minnidoka County, Idaho, where a rabbit drive is now in full swing, and 89,000 of the jacks have already been killed by the organized efforts of the community. The picture indicates sufficiently well the manner in which the rabbits that are to be found over a considerable expanse of territory are rounded up and driven into a corral, there to be dealt with according to the exigencies of the situation. We are rather accustomed to such tactics in dealing with horses, cattle, and other large animals, that they are effective with such a small and elusive creature as the rabbit may surprise us. In any event, it looks as though rabbit fur ought to be cheap for the coming season.



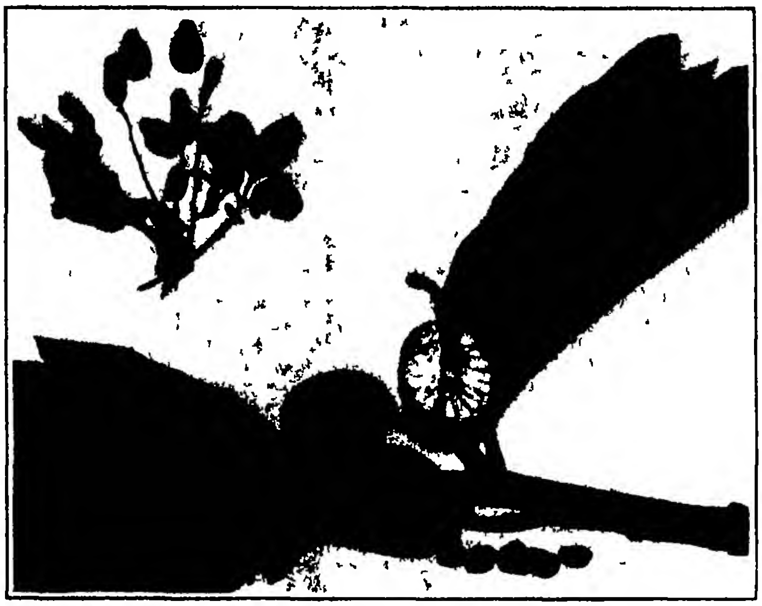
How the western irrigation farmers proceed against the rabbit pest, which has come to a point where action is necessary

More Combination Fruits and Nuts

THE account of the two remarkable fruits given in the SCIENTIFIC AMERICAN of December 13, 1919—a smooth skinned peach combined with an almond and the "raisin plum" whose pit contains an edible kernel resembling a hazelnut in flavor—gave facts that should encourage enterprising horticulturists to make a feature of growing them in such parts of the United States as may have a favorable climate. It seems strange that while these fruits should long have been imported in a limited way comparatively nothing should hitherto have been known of them outside of the foreign residents of New York among whom they had their market. The nectarine, of course, is simply a smooth skinned peach. But a nectarine that yields an almond into the bargain should be something worth anybody's attention.

The writer of the article, however, was in error in his assertion to the effect that these were the only known edible fruits that contained edible kernels. There are several others. One of the best known is the cashew, its delicious nut is constantly growing in favor and may be obtained very generally in our large cities. There are some most curious facts relating to it. The cashew nut is borne by the tree called *anacardium occidentale*, of American tropical origin, but now grown in nearly all tropical countries. The tree belongs to a large and widely diffused family that includes the mango and the pistachio. The pistachio nut, by the way, is another instance of an edible nut, or seed, contained in a fruit. But whether the pistachio fruit is edible or not does not appear. The nut comes chiefly from the Balkan peninsula and is common at Greek and Italian fruit stands in the season though the native American's chief contact with it is usually in his ice cream.

The cashew gets its English name from a phonetic attempt at the French name of the tree, *acajou*, which in turn is derived from the Brazilian name, *acaiaba*. In Porto Rico and perhaps the other Spanish West Indies, where the tree is common, it is called *pajuil* (pronounced *pah-wheel*). It is a handsome tree with a large glossy leaf. The blossom is insignificant, but deliciously fragrant. The relationship between the fruit and the nut of the cashew is so peculiar that it would, perhaps, be more in order to call the fruit the 'fruit of the seed' rather than to speak of the nut as the "seed of the fruit." This because the nut, which is kidney or bean-shaped, grows to full size before the fruit is formed. The long stem or 'hypocarp,' of the nut then begins to swell and grows rapidly until it forms a pear shaped edible fruit, half swallowing the nut which protrudes from the thick end, in a fashion most amazing to one who has never seen the species before.



Large picture: The breadfruit, which contains edible nuts imbedded in the edible flesh of the fruit. *Insert:* The remarkable fruit of the cashew tree, in which the edible nut of an edible fruit is attached to the outside of the fruit, which develops after the nut and partially surrounds the latter

Fruit and nut in one, two examples from Porto Rico

The manner of growth is not the only peculiarity of the cashew, as many have found to their sorrow. The shell of the nut contains a viscous and acrid oil, exceedingly caustic in character. The effect of this oil is similar to that of poison ivy upon persons with whom it comes in contact. The nut is roasted before it is sent to the market and the oil, evaporated by the heat, is expelled, leaving the nut harmless. But great care has to be taken in the roasting, for all persons susceptible to ivy-poisoning—and perhaps even others who are immune—are certain to contract a case of the most virulent kind if the fumes come in contact with them. Not a few persons who have had the raw nuts sent them by friends in the tropics without caution as to the importance of extreme care in the roasting, so that the fumes shall go either up chimney or be carried to windward have had a bitter experience in this respect.

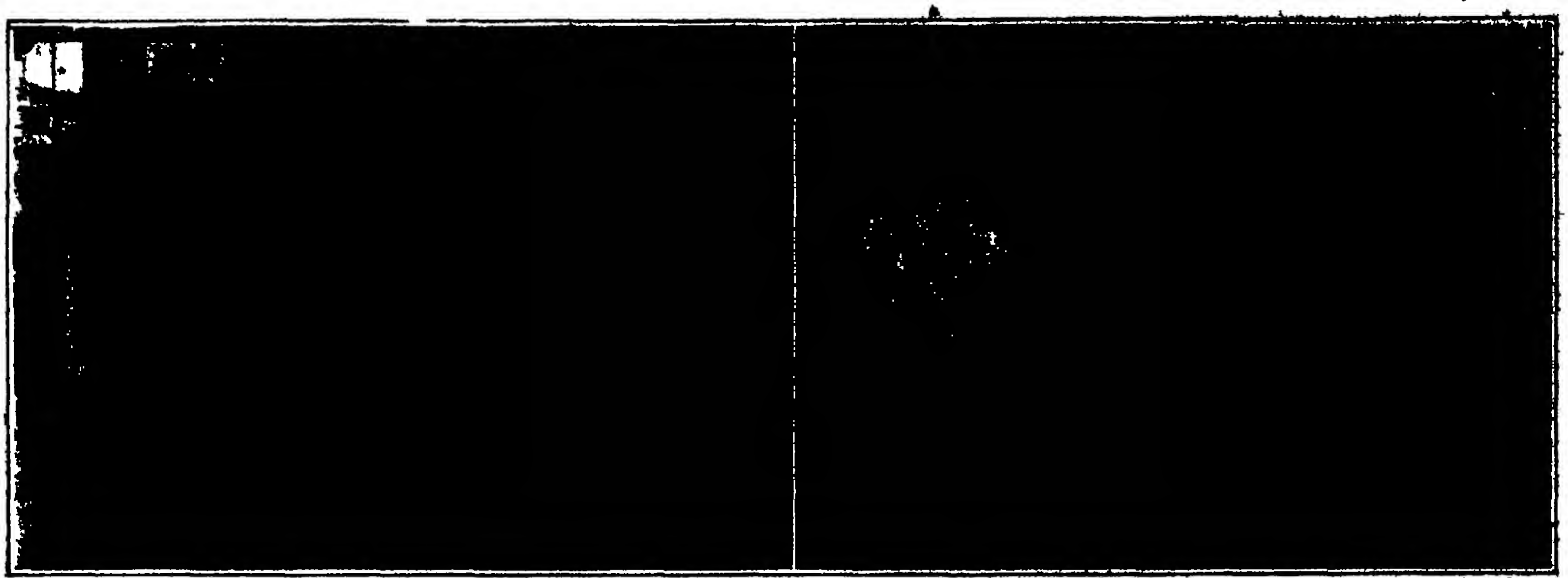
Another important edible fruit carrying an edible pit or seed is the mamey or *sapote mamey* a native of Mexico and other parts of tropical America. The tree is called the *mammea americana*. The mamey is a large fruit taking two years to mature. The tree is very prolific and carries the fruit in all stages of growth, so that it is continually coming to maturity. The large single seed is often the size of a hen's egg. When dried and ground into meal this seed is highly nutritious and palatable. The fruit is substantial in flesh, much like that of a pumpkin when cooked, within it is of a rich orange or terra-cotta color. Its flavor is such that a New England visitor in Mexico called it 'a sort of natural born pumpkin pie.' The seeds of the mamey are so large that a very few would make a pound. They could be so easily collected and the tree is so fruitful, that it should be possible to grow the fruit systematically solely on account of the food value of the seed; moreover, the exceedingly sweet fruit is so rich in sugar that it might be made of no little service in that respect by extracting the juice and reducing it to syrup or perhaps converting it to sugar.

Yet another nut bearing edible fruit is the famous breadfruit of Polynesia, borne by the beautiful tree called *artocarpus communis* now grown in the tropics all over the world. The fertile variety of the breadfruit, beside its edible flesh, contains an abundance of nuts the size of a large chestnut. These, either boiled or roasted, are most palatable and nutritious. Thus treated they are often ground into meal.

Where overalls are baled for shipment all over the world

Overalls by the Bale

WHEN our new suit comes home from the tailor's, it is carefully folded and wrapped in innumerable layers of tissue paper, and the whole placed in an individual box of its own with every precaution that it shall not acquire a single wrinkle. But every style of wearing apparel is not handled with the same degree of circumspection. Our picture shows the rough and ready style in which overalls for instance, are packed for shipment to foreign and domestic markets. They are pressed without ceremony into the smallest compass, and then done securely up in bales. Such treatment is altogether different from that accorded the noble dress suit.



Left: Removing the excess moisture from the clay before shaping it into dishes. The filter presses are made of compartments of strong sheeting through which water escapes to the drain below. *Right:* Shaping the clay on molds which remain inside the dish to support it while it is drying on the heated shelves of the background

Two steps in the transformation that converts wet clay into handsome china

An Ancient Art in Modern Dress

How the Potter Does, by Machine, the Same Things His Ancestors Did by Hand

By M. O. Goldsmith

THE first pottery was made by woman back in the Stone Age. But man soon discovered the fascination of shaping vessels of this stuff of the earth we call clay, the only substance he has ever found that can be molded and made to keep its shape when baked. Johnnie and his sister, repeating the history of civilization out in the backyard, in due time reach the pottery stage and begin to mix and shape and bake mud pies. Johnnie never thinks of it as girl's play. Neither does Johnnie's father, the potter. He knows that the making of earthenware today is a man's job.

The outsider may imagine that pottery is a simple art—that a lump of clay goes into a machine and comes out a dish. It doesn't. There is hardly a step in the long process that doesn't depend on the workman's skill and care. In fact the location of a pottery is marked not by the belching smoke and noisome odor that identifies other factories, but by the pile of ruins beside the wall—the smash and crash of some hundreds of broken dishes dumped out as pure waste, to be sold at a dollar and a half a ton to line the hearths of steel furnaces. All perhaps because at the moment when it was time to regulate the heat of the kiln, the fireman wasn't on his job. For a fireman can make or break a pottery.

All the output for a week, representing thousands of dollars, is fired at once in huge kilns two stories high, each holding perhaps seven thousand pieces. For two days and a half after the opening is bricked up and fires started, the heat gradually mounts higher and higher, the flames following the flues and wrapping around the oven and out again. There is no thermometer to tell when the critical temperature is reached, nor is there an automatic device to regulate the heat as is found in a steel plant or rubber factory. Things are happening there in the kiln, chemical changes that never happen twice alike in time or temperature. It is the action of the heat on the biscuit, as they call the unglazed pottery, that is important. And no automatic devices can tell that.

Instead, through a peephole in the wall the fireman watches three test cones of clay inside. You may wonder how he can stand the heat, but the walls are so thick and the peephole so small that there is no rush of flame in his direction. When the peak of cone No. 1 begins to tilt he knows its melting point has been reached and he knows what stage in the firing that melting represents. No. 2 has a higher melting point and bears watching. But the tilting of No. 3 is a signal to stop stoking.

All this time he has not been able to observe the biscuit itself, for that is tightly packed in big fireclay boxes, saggers. He is doubtless oblivious to the beautiful colors these rude saggers take on after much firing—a rich brown shading off into copper and orange. His interest is in the contents. But their fate he cannot know for another two days. It would be disastrous if the kiln cooled down quickly and the biscuit contracted at a too speedy rate.

When the suspense is over he may discover that some of the saggers were not tightly caulked in the

Stacking in the kiln the fireclay boxes filled with raw earthenware

The dipper, who has to determine instantly, by the feel of each piece as he picks it up, how much glaze it needs

preparation for firing. Sulfur fumes from the coal have found entrance and ruined the contents by discoloration. Or right at the start, a goodly percentage of the biscuit may have been doomed, if the man who mixes the clay, determining the different proportions by weight, failed to calculate correctly the varying amount of moisture in the raw clay and to alter his mixing proportions accordingly. The mistake won't show up in the slip house, where the clays and the powdered flint are mixed with water into a thick cream that may well be called slip. But the truth will out when the biscuit is examined after firing.

Some of the baked ware may show defective specks because in the running of the slip over magnets to remove the iron, or in the straining through fine lawn sieves, some impurities still remained. The purifying, filtering and mixing of the clay are mechanical processes in which the American potter has made great improvements.

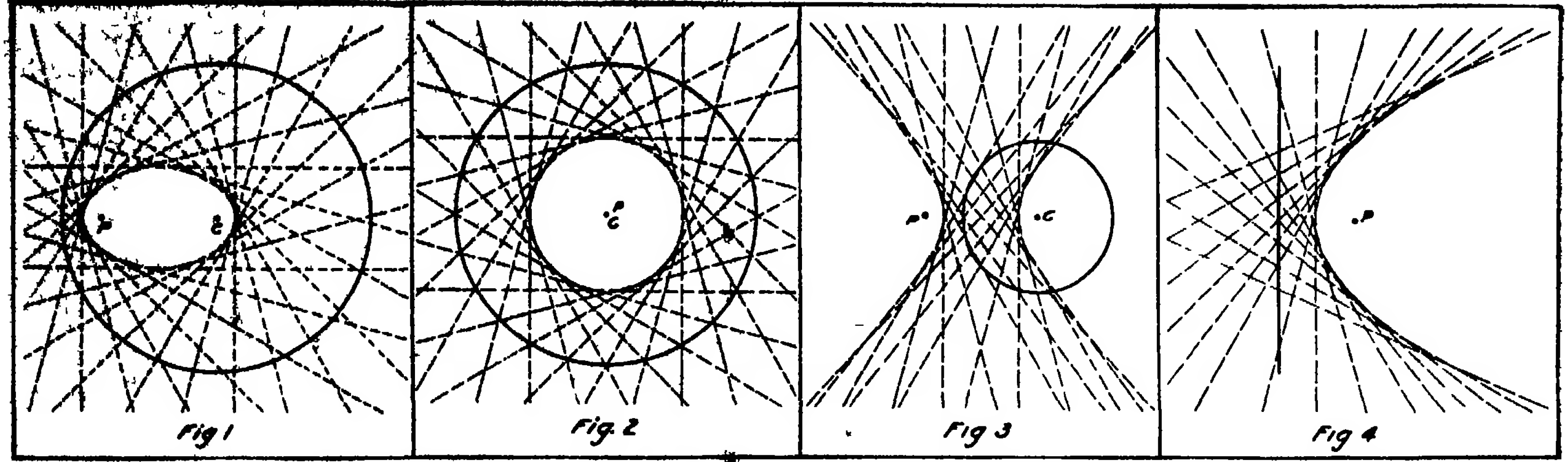
In England it would be counted a sacrilege to wash the windows of the pottery or to whitewash the walls to keep the white powdery clay within bounds, or to group the processes to avoid waste of time and effort. In the fine china potteries of Britain they knead the clay not by means of a pugmill, but by hand. A man whacks the clay with a huge mallet, and thereby does something to it that machinery cannot do, just as the woman who kneads her bread and does not trust it to the mixing machine gets bread of a better quality. It was to get this quality in the dishes made for royalty that in the old days men trod barefoot on the clay.

One can hardly imagine our labor doing that—nor can one imagine our potteries turning out anything like the Wedgwood Queensware. Our achievement is in making good ware, cheap enough for every woman to queen with. Democracy even in pottery!

But no amount of mechanical devices can make the American pottery independent of the worker. Besides the fireman, who plays such an important part in the firing of the biscuit and again in the lighter firing of the glaze, there are three important men—the jiggerman, the jollier and the dipper. It takes three years for an apprentice to acquire the skill for any one of these jobs.

The jiggerman shapes flat pieces, plates and platters. He takes a bat of clay, the thick pancake that the "batter out" has formed, and throws it with what is to be the top side down on to a plaster mold. This mold, which is to accompany the plate, absorbing its moisture until it is thoroughly dried, shapes the inside of the plate. The jiggerman revolves the mold and its burden of clay before him, at the same time bringing to bear against the outside of the plate a steel profile that presses the clay against the mold and shapes the back. A little mold-runner at the jiggerman's elbow does nothing but carry the newly shaped plates, each

(Continued on page 134)



In this method of constructing ellipses (Fig. 1), circles, (Fig. 2), hyperbolas (Fig. 3) and parabolas (Fig 4) by folding paper, the mathematician will recognize an application of the envelope principle

Laying Out Curves by Folding Paper

ON a piece of thin paper or tracing cloth draw a circle (Fig. 1) and take any point P within the circle. Fold the paper so that the point P falls somewhere on the circumference of the circle, and crease it down hard. Open up the paper and in the same manner fold it again and again so that the point P falls successively on a number of points completely around the circumference It will be found that the successive creases in the paper have traced out an ellipse, as shown by the dotted lines in Fig. 1 The transverse axis of this ellipse is equal to the radius of the given circle, and the foci are the point P and the center C of the circle

If we prepare several pieces of paper with the point P taken successively nearer the center C of the circle, the resulting ellipses will be found to have successively less eccentricity and to approach a circle in shape, until finally when the point P coincides with the center of the circle, as in Fig 2, the curve traced by the creases is a circle.

If, now, we consider the point P as moving farther from the center of the circle, the resulting ellipses—with transverse axes always equal to the radius of the given circle—become flatter, until, when the point P is actually on the circumference of the circle, the ellipse degenerates into a straight line.

As soon as the point P crosses the circumference and is outside of the circle, the creases in the paper trace an hyperbola. As in the ellipse, the transverse axis of the hyperbola is equal to the radius of the circle and the foci are the point P and the center C of the circle (Fig 3)

When the given circle is considered to increase indefinitely in size until the comparatively small portion of its circumference that can be shown on a sheet of paper is practically a straight line, the curve traced by the creases resulting from folding the point P on successive points along this straight line is a parabola The point P is the focus of the parabola, and the straight line its directrix (Fig 4)

That these curves are true "conic sections and not haphazard shapes may be proved by anyone familiar with the methods of analytical geometry—the equation of any one of the creases, referred to rectangular coordinates, may be thrown into a form recognizable as the equation to a tangent to the particular curve under investigation.—By *Francis M Weston, Jr*

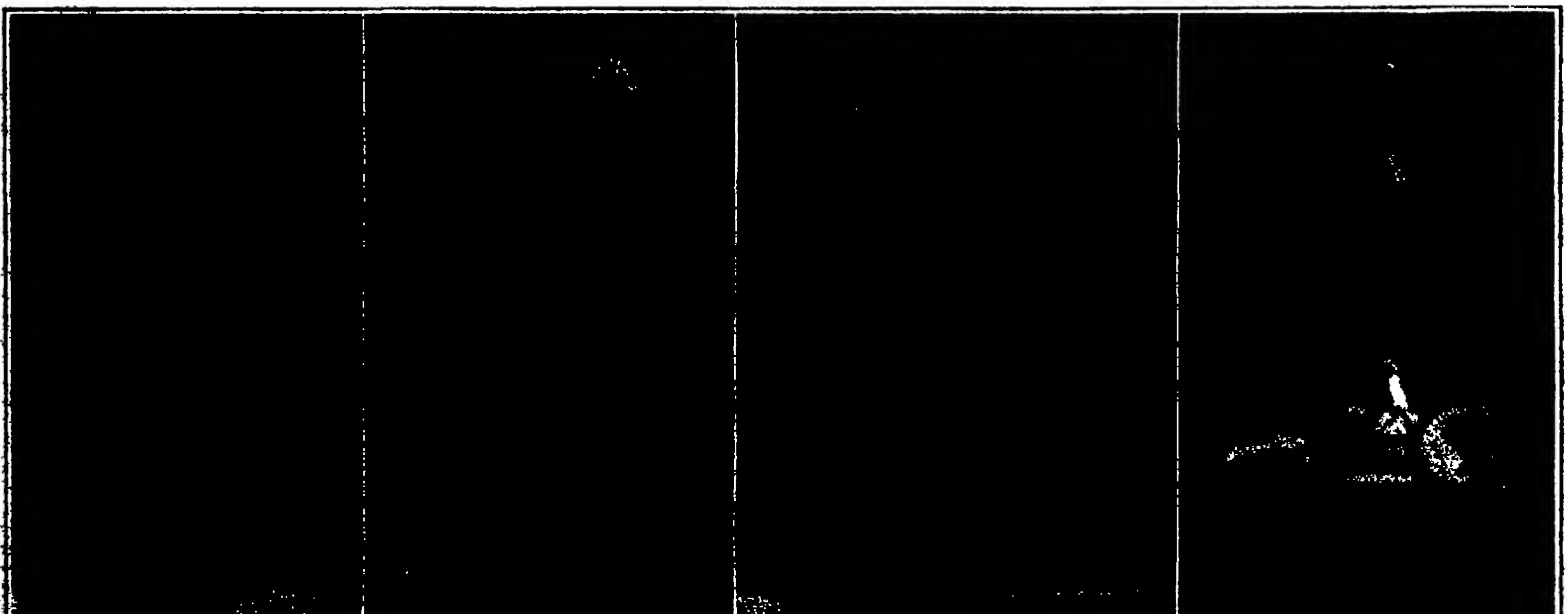
Tricks With Bottle and Glass

AMONG the old friends that are always new are the bottle and glass tricks which are brought to our attention every little while One of the most surprising, to those who have never seen it before, is the spinning of a plate on a needle-point. The first property for this stunt is a bottle A needle is driven firmly into the cork, leaving a goodly section of the steel projecting upward A second cork is cut into four pieces, as nearly equal in weight as convenient, and into each of the fragments a fork is securely fixed It is of course necessary that the forks be uniform, and that enough of the cork project at the front of each so that the forks may be suspended about the edge of a dinner plate as indicated in the picture When all these preliminaries have been attended to the plate and all its contents may be spun upon the end of the needle without even threatening to fall off The secret, of course, lies in the low center of gravity of the ensemble

Balancing an egg in any position on the edge of a bottle-neck is another trick that will startle the uninitiated This time it is the egg that has to undergo a process of preparation It must be punctured at both ends and blown and then filled with fine sand That is all It will then stand wherever and however we put it—again because of the fact that in all its positions the center of gravity falls within the base on which it is standing

Knowledge of how to do it rather than any special preparation is necessary for the third trick illustrated, in which a needle is driven through a coin contrary to the impression which anyone would register that it cannot be done The coin must be placed across the opening between two tables or two books, so that its center is clear beneath Then the needle must be inserted in a cork in such fashion that its point projects on the one side while its head is about flush with the surface of the cork on the other Under no circumstances must the head be exposed so that the force of the blow can fall directly upon it, however If the instructions are faithfully observed, a single sharp blow from the hammer will penetrate the coin

A balancing trick comes next It is plain enough when once explained The pedestal consists of an ordinary drinking glass, in the opening of which a big flat cork has been secured On this are put three wineglasses, rimwise, as indicated in the picture, and the only trick is the holding of these in place until the bottle can be set over them Once there, the pinnacle-piece will hold the assembly together very nicely



Four surprising tricks that may be performed with bottles, glasses and corks, as explained in the text

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

First Aid to the Carburetor

THERE are gas savers and gas savers but when one goes out to get a story on one of these devices he is usually disappointed to find it nothing beyond the familiar idea of supplying more hot air to the mixture after it passes through the carburetor When a gasoline economizer appears that acts in some other way we have a story of more than common interest

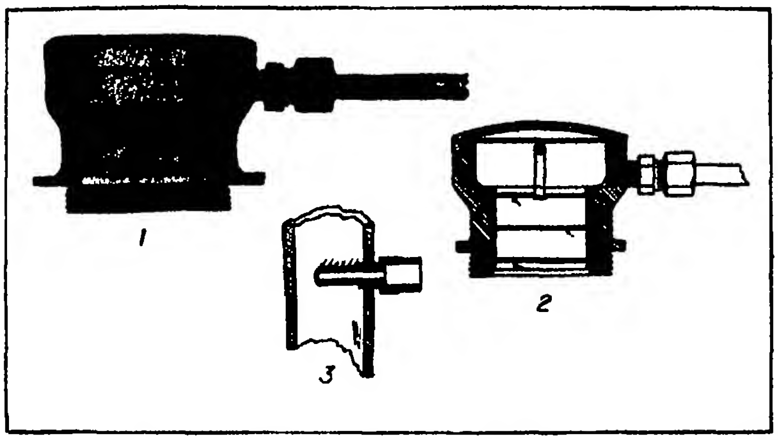
The carburetor is not, inherently an efficient mechanism especially with the sort of fuels we feed it today Its goal is the manufacture of a completely gaseous mixture of air and gasoline, entirely analogous to that of oxygen and nitrogen in the air itself The ordinary result falls far short of this in that a considerable quantity of the gasoline is *not gasified or mixed at all, but is car*ried into the intake manifold in the form of minute drops of liquid, suspended in the current of gas Such drops may burn but they can never explode

The present inventor may have got his inspiration by applying his nose to the orifice of a gasoline tank and realizing from the odor that in the atmosphere immediately above the liquid a natural process of carburetion was going on But here no drops of liquid are sprayed into the air the explosive mixture being produced solely through the ability of the air to absorb the volatile liquid in gaseous form In this mixture there will be no droplets—nothing but explosive gas. Why not introduce it into the cylinders?

That is precisely what the apparatus pictured does. A pipe is threaded into a hole bored in the intake manifold, and its other end carried to a member that screws over the filling hole in the fuel tank As soon as the engine turns over suction is set up in this auxiliary feed line as well as in the regular one, the vapor from the fuel tank runs into the intake, there joining the mixture from the carburetor

Among the details worthy of attention may be mentioned the safety arrangement Every engine backfires now and then Under standard practice the worst thing that can follow is the blowing out of the carburetor But an engine that can backfire directly into the fuel tank would be something more serious So in this device the auxiliary feed enters the intake manifold through a tiny nozzle, shown at 3 in our diagram, the holes in which are extremely minute In the second place if combustion should get through these, it would be

(Continued on page 124)



1 External appearance of the member that fits over the filling hole in the fuel tank. 2 Section of this member 3 Section of the plug that screws into the intake manifold the arrows indicate the tiny holes out of which the gas issues

Gas from the fuel-tank to help out the carburetor

The Handling of Awkward Materials

HAND transportation is rapidly giving way to power-driven devices The most difficult material to handle is long stuff In fact, until the appearance of the new straddle truck which is shown in the accompanying illustration, the handling of awkward materials has always presented a problem which had to be solved with improvisations.

The new straddle truck imposes no limit to the length or height of load The top of the platform or bolsters need only be four or five inches above the floor, and no small wheels are required to go underneath the platforms This is an advantage in hauling heavy articles like machinery Material to be transported is piled on platforms or in boxes and long stuff may be placed on two simple bolsters. Loading and unloading are thus accomplished while the truck is busy doing useful work.

Structural steel may be readily handled with this straddle truck. The lengths that may be handled are practically limited only by the space available for turning And as the center of turning radius virtually coincides with center of length of load, the action is almost equivalent to a turntable By means of platform units, package freight, heavy machinery and other articles can be readily handled, as shown

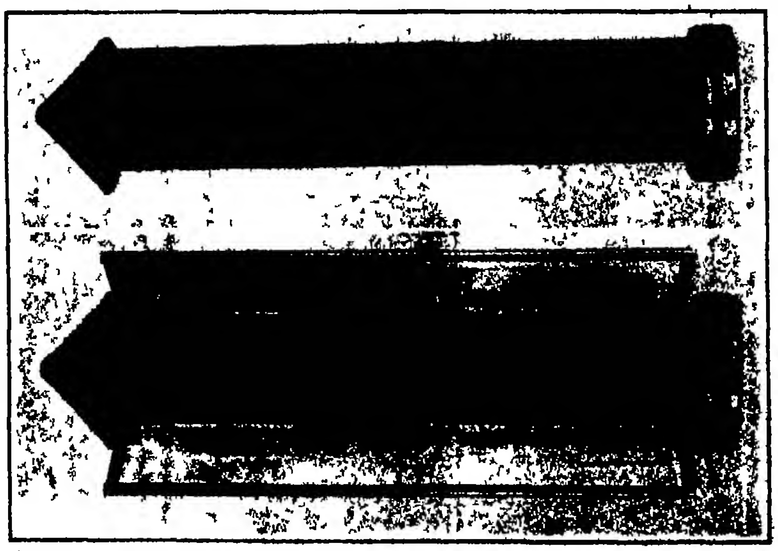
The straddle carrier is the invention of H B Ross of Benton Harbor, Mich. It will be recalled that a larger machine of this kind is being employed in lumber yards The present machine, like the larger one, is driven by storage battery The hoisting gear, which is motor-driven, will sustain the load at any point of lift, but at the maximum lift all load strains are relieved from the gearing. The operator cannot raise the load above a fixed point

Two views of the straddle carrier, showing its use in handling structural iron and in handling heavy machinery by means of platform units

A Collapsible Kaleidoscope for the Inquisitive

A MANUFACTURER of physical apparatus in Cambridge, Mass. has introduced an interesting kaleidoscope which will give the young student an idea of how this instrument works.

This kaleidoscope, shown open and closed, is made wholly of metal, with the exception of the reflecting mirrors. The tube consists of three strips of metal two of which are hinged to the third as shown in the lower figure. Upon these are mounted strips of glass mirror plate, which give the beautiful figures formed by the objects in the cell or box at the bottom A hook on one of the sides holds them together when closed as shown in the right-hand view The conical part at the top has an opening about a quarter of an inch in diameter for viewing purposes. This as well as the box at the bottom is fastened firmly to the strip to which the doors are hinged This box has a clear glass side on the inside and a ground glass side on the outside. In this box are placed the bits of colored glass, or other more elaborate objects found in some kaleidoscopes, which form the beautiful figures seen on looking through the tube toward the light. The figures formed in this instrument are six-sided, because the angle between the mirrors is 60 degrees and this is contained in 360 degrees of a circumference 6 times. By rolling the kaleidoscope as one looks through the tube an endless variety of figures is formed, all of them beautiful and no two alike.



The collapsible kaleidoscope, shown closed for operation and open so as to reveal its parts to the inquisitive user

Railroading Under Roof

(Continued from page 118)

ing received the staff entitling him to possession of the block releases the brakes and proceeds. A skilful and almost continuous use of the brakes is required to keep within the passenger train speed limit of 28 miles an hour Several times during the coast down the mountain the train stops for about five minutes to allow the wheels to cool.

For freight trains still greater precautions are necessary The head engineer on west-bound freights applies the brakes and stops a little more than a train length after leaving Tunnel No 6 which is on the east side of the Summit If he did not stop he would run through a siding, out of the sheds and on to the ground, for the switch is always set for the siding and must be thrown by the head brakeman. After the helper is cut off the engineer charges the train following which all retaining valves are turned up. Then the air is tried by opening the angle cock at the rear of the caboose which sets all the brakes.

If all is well the brakes release and the engineer, having received the staff proceeds without waiting for a signal from the rear of the train for the excellent reason that no signal could be given All communication between front and rear of the train is entirely cut off while the train is in the shed and all usual methods of operation are abandoned The flag man hangs a Dietz lantern under the rear platform close to the track and stations himself on the platform where he keeps a close watch of the track If he sees ties freshly splintered he knows a car is off, so he opens the emergency valve and stops the train

So long as the lights at the entrance to each block are both green the engineer keeps going, exchanging staffs by means of a staff catcher at the side of the cab But if the home signal is red and the distant signal is yellow he retains his staff and enters the siding There being no way to get a signal from the rear of the train the engineer watches the signs on the side of the shed which are numbered "20," "25," "30," and so on until he is opposite the number corresponding to the number of cars in his train, when he knows he is in to clear, so he stops and stays until the opposing trains pass.

Six times during the descent of the mountain the train halts while the train is inspected as the wheels are cooling A man on each side passes along the length of the train looking for brake beams down, cracked or broken wheels and noting the temperature of the wheels. If a car has wheels too warm the retainer is turned down to give the wheels a rest except when the engineer holds the brakes on. If a car has hot wheels the brake-piston travel and the brake rigging are investigated to see if the brake shoes are being held against the wheels. Often the wheels are hot enough to burn the fingers, sometimes they are red hot, sometimes they get hot enough to burst. But sometimes they are so cool they show that the cars are not doing their share of holding the train

Two Wompuses are assigned to a fruit "block" of 45 cars east bound, the helper being placed ten cars from the rear end In the sheds not even the usual whistle signals between lead engine and helper can be exchanged, for whistle signals cannot be heard. So when a train pulls in on a siding the head engineer releases his brakes and lets the slack run back on the helper who sets his independent driver brakes as soon as he comes to a stop. When the lead engineer is ready to go he sets the brakes with a heavy reduction, then releases. The engineer on the helper takes the release as a signal to go, releases his independent driver brakes and begins to work steam.

The engineer cannot even get a signal from the fireman in taking water in the sheds. Instead he stops at a mark opposite his window All flagging is done by torpedoes. Section men and bridge carpenters, who are constantly at work in the sheds put out torpedoes on each side The roar in the sheds is so great that even torpedoes cannot always be heard but a well-trained nose can smell them The engineer also depends on his sense of smell to warn him that drivers are slipping otherwise he might never know it In the same way the engineer detects hot boxes.

His sense of touch guides the engineer in the use of throttle and brake valve He has no means of knowing whether the injector is working except by feeling the supply pipe, for if he put his head out of the window to look at the waste pipe he would get it knocked off

A break-in-two in the sheds means a delay of an hour to two hours. A man has to walk over the train for he cannot walk beside it in winter, to find out what is wrong Then he has to walk to the caboose, hoist a chain to the top of the cars, drag it along to the break, walk over the top to the engine, tell the engineer exactly how far to back up chain the break together, then walk to the engine once more to tell the engineer to go ahead for there is no possibility of passing signals.

Saving St. Paul's in London

(Continued from page 113)

repairs of the southwest and southeast piers took place owing to crushing of the stone casing

The building itself gives us the best indications of what happens We find that the impost molding in the crypt has a 3 inch band of stone underneath it, which is a pretty sure indication that the pier sank that much before the impost was placed in its present position

We are face to face with certain facts First, the masonry of the piers has been crushed Second, the agglomerate of the piers is not as good as it should be Third, to whatever cause it may be due, the piers have settled Therefore, our best course is to make the piers as sound as we can, and, like Wren, trust the foundations to keep up the present fabric as it did its predecessor This, then is our present endeavor We cut out stone by stone the crushed masonry, and reinsert sound, using every care not to remove too much at a time That so far we have been successful is a tribute to the vigilance of the workmen and the efficient supervision of the contractors The first pier (southwest) has been practically renewed without an appreciable crack being visible We are now treating the southeast pier in the same way After we have inserted the new stone we endeavor to consolidate the rubble as far as possible by pouring in liquid grout by gravitation. As a safeguard against any unforeseen settlement, we are erecting a steel center under the South Transept Arch to pick up the weight should any failure of this work take place

Getting the Rest of the Oil

(Continued from page 114)

rock in its structure. Therefore, it is practicable to duplicate in miniature the several strata that influence directly the underground migrations of oil, water, and gas when man disturbs nature's subterranean equilibrium.

The heavy face plate of the tank permits the experimenter to watch the changes promoted by the application of the forces and by the introduction of fluids at his disposal Again, when the test covers an interval of some hours, for example, photographic records can be made at prescribed intervals. In this way are obtained data which can be examined at leisure. Facts of importance are thus brought to light which might escape observation during the shifting of the masses. It should be mentioned here that the Mills apparatus is large enough to allow the investigations to be conducted on a scale of sufficient magnitude to avoid any misleading effects of capillarity By using sands that are more or less saturated with oil and water, the capillary forces at work are far weaker than the other ones that are deliberately called into action by the investigator and the latter are subject of his immediate inquiry It should be understood, of course, that the experimental tanks can be carried to laboratories situated in the oil fields, and there employed agreeably to the geological conditions disclosed by the driller's log and other information obtained during the operation of a well or group of wells.

It has for many years been suspected that the migration of oil under ground, once man destroyed the balance of the pent-up energy, might cause the petroleum to be trapped so that it could not be drawn surfaceward by the pumps of existing wells and, similarly, it was believed that a lack of understanding on the part of the operator led all too often to movements below ground that would shorten to a greater or lesser extent the profitable productive life of a well or wells Mr Mills has confirmed these assumptions and his tanks give visible evidence of much suggestive value

He has made it clear that, with suitable information available, it is possible to adopt preventive measures that may be counted upon to check or correct subterranean water troubles that have interfered or threatened to interfere with a well's yield of oil, and thus to prolong to a marked degree the life of that well and, perhaps, of a wide neighboring area Again, in a kindred way, his tests disclose how the 'nursing' of the natural gas associated with a given pool arresting its untimely escape, may serve to drive the oil to the shot holes or pump intakes, and eventually bring about the extraction of a far larger percentage of the petroleum than might otherwise be feasible And then, the apparatus has revealed how compressed air, forced down from the surface may be relied upon to take the place of the vanished natural gas in promoting the recovery of oil Finally, if time be allowed for the disturbed or remaining fluids to readjust themselves, it seems that the oil may assume another position which may aid its extraction In other words, intermittent pumping of a well may give better results than continuous operation, and even apparently exhausted wells, in some circumstances, may be found productive after a period of inaction.

Enemies of Timber Construction

(Continued from page 118)

Atlantic and Pacific coasts of America and the coasts of Europe The *chelura* is another diminutive enemy of submerged construction in salt water It occurs in great swarms and the mode of attack is similar to that of the limnoria Common names are sea fleas and red wood lice The *sphæroma* is yet another shell animal. It resembles the limnoria, but has a rounded instead of a flattened body It is a little bigger, excavating a burrow with a diameter of 1/8 to 3/16 inch and a depth of 1/4 to 1/4 inch It is less common than the limnoria, but infests fresh as well as salt water The *martesia* is still another enemy of marine construction. When the martesia enters a timber, the perforation will be only about 1/4 inch in diameter, but the burrow inside may reach a diameter of 1 inch It is thought that the burrow is not excavated for food but for use as a retreat. The head is bivalvular It is pretty much the whole affair When operating upon a timber, the head opens and a hard and rough tongue begins action As it works back and forth, the hole is cut. The martesia does not seem particular as to the material into which it bores. Tar

paper, asphalt coating and the contained pile—all seem to yield to its efforts. It is even claimed that it will cut into rock. A metal sheath appears however to be proof against it. Apparently this animal has not given a great deal of trouble to engineers as yet. However it has appeared near the Pearl Harbor dry dock in the Hawaiian Islands and elsewhere in that general neighborhood.

Engineers, contractors and others concerned are desirous of safeguarding submerged wooden structures. Wood when continually submerged, is a fine material for foundation purposes. Concrete may generally be substituted but the expense is often very considerable, partly because of transportation and partly because of other considerations. Suitable timbers are often available nearby and at advantageous costs. The world over timber substructures are probably very much oftener to be found in salt water construction. The most serious objection—apart from the susceptibility to the attacks of marine borers—is that wood above the water line is rather subject to deterioration. This is something however which may be pretty well predetermined. The operations of the teredo and its allies are scarcely subject to exact determination in advance. All kinds of prevention methods have been tried. The wood has been impregnated with this or that chemical; the timber has been painted with various substances; the pile has been wrapped or sheathed with numerous varieties of coverings.

Creosoted piles have had a life of 18 to 20 years. These were sticks taken from Long Wharf. They were, in fact, not removed because no longer useful but because the structure was being dismantled. San Francisco Bay is a body of water swarming with various boring mollusks. There is a long trestle reaching out beyond 2 miles from shore but not into deep water. At the point 2 miles out the water is only 5 feet deep and at the terminal from 12 to 30. These depths are at low water. Untreated piles put down in 1902 had many of them, already broken off and been carried away by 1908. But the trestle still stood. In 1906 and 1908 piles of Douglas fir were protected by paraffin paint from the mud to high water lines. In 1912 a detailed examination was made which showed that the teredo had not been especially active in the inner 2 mile section. But the limnoria had been quite successful in coning piles off from the high water level down to the mud line. When a pile had only about 2 inches of sound wood left it would break off. Nevertheless some piles were found to have had a life of 8 to 12 years. The teredo and the limnoria did well for themselves in the section beyond the 2 mile point. The piling would break off just above the mud. There was uniform coning from high water down to the mud. The section in this region would be 6 or 8 inches through and completely honeycombed by teredo burrows. Under the terminal structure piles had a susceptible region 18 feet long between high water and mud but other timbers were so located that the mud was 32 feet below high water. Nevertheless the limnoria and the teredo got in their work.

Perhaps less attention has been given to the destructive activities of land forms of life. The *white ant* may be regarded as the leader of these, insofar as timber construction is concerned. It attacks the wood of the foundation timbers and of the planks in basement floors. This pest operates not only upon structures in the country but also upon those in large cities. While the South Atlantic and Gulf states constitute the region most infested, the northern states are also liable to invasion. The white ant is known to have been active as far north as Manchester, N. H. and Benton Harbor, Mich. It attacks wood that is partly in contact with the ground or which is so situated as to be accessible from it. Concrete may not prove effective as a protective sheath, since weathering or settlement productive of cracks may open the way to the wood. The favorite regions for white-ant activities are those that are dark, warm and moist. They work readily in damp or decayed wood. But where penetration is impossible the white ant may still pass the barrier by means of little shelter sheds or earthlike tubes. It constructs these of earth and excrement and runs them if need be up from the ground.

The timbers of bridges and wharves, telephone and telegraph poles, mine props, railroad cross-ties, express water tanks, etc., are subject to attack, under favorable circumstances. The ants are able to penetrate dry hard wood, even though it is elevated above the ground, provided the intervening obstacles are not too great. Moisture somewhere is needed—preferably in the form of moist earth—but not necessarily at the point of activity. By mixing moist earth and the wood which has passed through the body the white ant is able upon occasion to create more favorable conditions as to moisture.

An Ancient Art in Modern Dress

(Continued from page 120)

on its mold, to the moving shelves that convey them through a heated air shaft until dry. The jollier is like the jiggerman except that he works with cups and bowls where the steel profile shapes the inside instead of the outside of the pieces.

Some irregular pieces, such as pitchers, have to be pressed by hand against a plaster mold, each half of the pitcher being formed separately between two plaster molds and partly dried before it is dipped in thick slip which acts as mucilage to join the handle to the rest of the jug.

One is tempted to linger, watching the creation of forms from shapeless clay. But there is still the drying, sponging, smoothing, and firing of the biscuit before we come to the wonderman, the dipper. Seeing the ware handled so many times and undergoing trial by fire one marvels that there is anything left by the time it gets to him, or as a result of his work. For there is always the risk that the dipper will put on too much or too little glaze. As he takes in his wet fingers a piece of baked earthenware, each piece differing in its degree of porosity, he has to determine instantly by the feeling of the water being sucked into the pores of the biscuit, how long to let the piece remain in the tub of liquid glaze, a matter only of seconds anyhow, and how much glaze to shake off. If too little adheres, the dishes will be rough when the glaze is fired, and if too much the glaze when fired will be discolored. What is worse, it will crackle in heat or cold, letting stains and grease come in contact with the porous body below.

The glaze is what gives to earthenware its shiny, dense surface. This surface is an aid to long life and a protection against germs, stains and grease marks. Moreover, when earthenware is decorated under the transparent glaze, the glaze protects and preserves the design. The three lumps on the back of a plate or cup show where it was supported so it would not adhere to another in the melting of the glaze. These rough places have been almost smoothed off by girls with dressing irons who have the knack of hitting the lump and not the dish.

First Aid to the Carburetor

(Continued from page 122)

stopped by the three diaphragms of the filling-hole cap, with their staggered pin holes as shown by the arrows at 2. As a result of all this the apparatus carries the indorsement of the fire underwriters.

When we bring fuel to the engine in this novel fashion, we do not get enough fuel or sufficiently rich fuel, to drive an automobile. What we do do is to enrich with this direct feed the fuel fed through the carburetor in the ordinary fashion. The carburetor is now called upon to supply only a part of the explosive charge, the more efficient part being supplied by the new means; so, in the end, less gasoline is burned to secure a given result than if the entire charge were supplied by the inefficient carburetor. The setting of the carburetor is much leaner with the attachment than without, and this affords the visible means of the economy.

The Editor was not willing to admit this argument as more than a mere argument until he had seen it demonstrated. So a Ford car on which the attachment had been installed for some time was driven over a course of about twenty miles, first with the device and then without it. In the test with the device the carburetor was not tampered with, but was left as the owner had been running it. In the other test, it was necessary to adjust it to a richer mixture in order to run the car at all. The Editor took charge of this business, and throughout the run manipulated the dash control in such style that the mixture was maintained as lean as it could be without causing the engine to buck.

Before the test the gasoline stood exactly six inches high in the rectangular tank; after the first leg at 5.55 inches, after the second at 4.87 inches. It will be seen that this gives a fifty per cent improvement running with the "gasifier."

In the way of general remarks, it may be pointed out that the apparatus can be detached for a test or for other reasons with singular ease. The plug that carries the line into the intake manifold has only to be removed and a solid plug screwed in in its place. Such a solid plug is part of the apparatus as supplied. The device is operative on any car that has gravity or vacuum feed, the pressure feed alone being barrier. It is sold under a guarantee of fifty per cent improvement, and we are told often scores much more than this.

During the test that was conducted for our benefit the carburetor adjustment was so lean when the device was in operation that with the engine idling, a half turn of the adjusting rod was sufficient to stall it. The difference in adjustment between the two runs was about 1¼ turns. As evidence of the powerful suction in the auxiliary fuel line the screw top was removed from the member that covers the filling hole in the tank, there was an audible rush of air through the line that stalled the engine instantaneously. From the distance covered and the height of the gasoline the performance was worked out in terms of gasoline-miles, and found to be 20¾ without the new device and 31¼ with it. This shows that the car was in good order, without having been tuned up for the test. It was of course examined for hidden fuel chambers and other artifices, and found to be a perfectly regular coupe, plus the gas-saving installation. Unlike many of the fuel savers, this one is not restricted in its application to the Tin Lizzie, but is made for all cars and is equally effective on them all—barring, of course, the pressure feed. The manufacturer claims that the high-grade gas from the fuel tank not alone saves gasoline, but increases power. The car used in the test ran very satisfactorily throughout, and barring a possible slight difference in acceleration, we were unable to verify this; but it is of course entirely reasonable.

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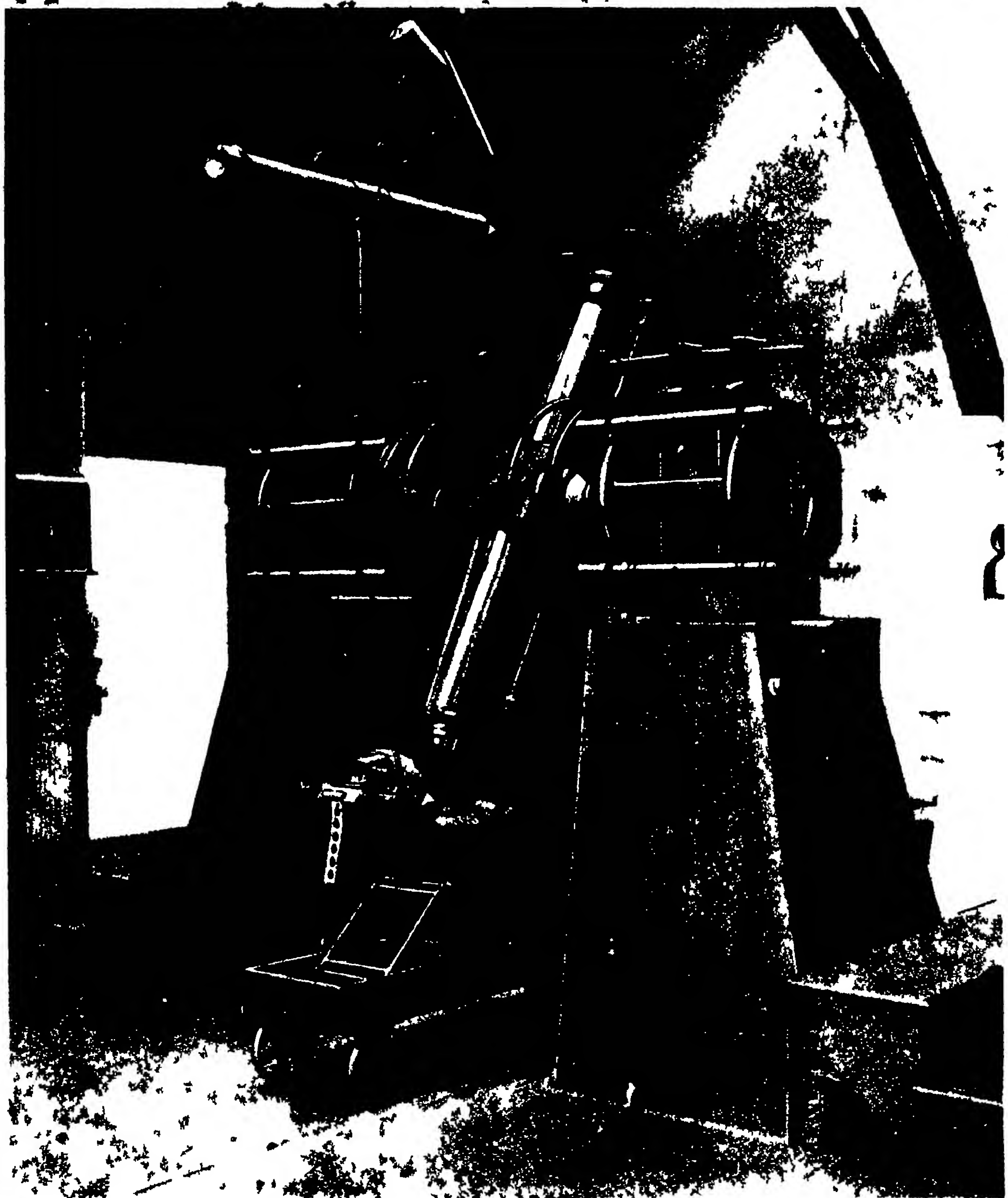
DOING AWAY WITH THE ICE MAN
PAINTING WITH METAL SPRAY

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



OBSERVING THE STARS IN ORDER TO DETERMINE OUR STANDARD TIME.

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The Races in the United States

UNCLE SAM S decennial job of counting noses—and incidentally of making a few observations with regard to the age race, nativity and miscellaneous circumstances of the proprietors of the noses—proceeds apace, and has now reached the point where complete tabulation of the returns is possible under certain heads In particular the Census Bureau recently made public the figures showing our population by states, according to race and color

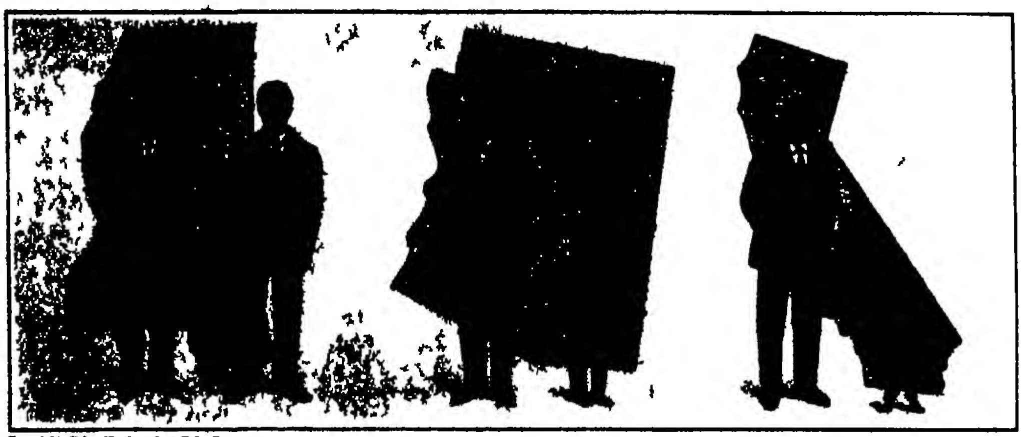
In the United States as a whole, the gentlemen who circulated about the country with pencil and big flat book last year were able to find 105,710 620 individuals Of these 94,822 431 are classified as white 10 463 013 as negro, 111 025 as Japanese and 61,686 as Chinese—making a total of 172,711 for what we may [illegible], in spite of the [illegible] protest made by both elements of such common classification as the yellow races 242,959 as American Indians and 9508 as 'miscellaneous'— Eskimos, Malays etc etc, etc Reducing the figures to a more accustomed basis we find that, ignoring this minute miscellaneous residuum altogether, the Indians make up but 23 one hundredths of one per cent of our total population and the yellow people but 16 one-hundredths, so that we need not be surprised to find that the whites, with 90 per cent and the negroes with 10 per cent, seem to account for the whole Or of every thousand people in the United States, 897 are white, 99 black, 2¼ red, and 1¾ yellow

The distribution, as every one knows, is not uniform If we divide the country into three sections, north south and west, we find that the black men are in the south as we should have supposed, while the yellow ones are in the West, as California would have us believe. The Indians do not permit any such categorical statement, the presence of Minnesota and the Dakotas in the "north," with a few other states in less degree bringing it about that this section has 60 000 aborigines Oklahoma and North Carolina bring the total of the South up to 75 000 and the remaining 108 000 are in the West where we would have looked for them

It is of interest perhaps to compute a few sectional percentages The South comprising everything south of the Mason and Dixon line and the northern line of Arkansas and Oklahoma has 2[illegible] per cent of its people negroes and the remaining 78 per cent—neglecting the few of other races—white For the North barely two per cent of the population is black and for the West a bare 8/10 of one per cent

More illuminating figures may be obtained if we take individual states Two states have a majority of their residents from the black race South Carolina and Mississippi The latter named state shows the larger proportion with 94 negroes to 87 whites or 52 per cent black This is one of the states showing a decrease in population for the decade since 1910 and an examination of the figures shows this decrease to be attributable to the black population which has fallen off by 74 000 while the whites were increasing by 6800

Everybody we believe knows that the two states mentioned as having the greatest negro population are as they are Most of us are sufficiently informed that California has the heaviest percentage of yellow residents We should however probably be hard put to it to guess where the Indian bulks the largest The answer is in Arizona where there are three red men to every 29 whites—the Indians constituting very close to ten per cent of the whole population Applying the same process to the Chinese and Japanese of California we find that this state has one yellow man to every 3[illegible] ½ whites which is to say the Oriental races constitute a trifle less than three per cent of the state s total These are the figures which are displayed graphically in the drawings on this page the (three dimensional) bulk of the manikins being in proportion with the numbers which they are designed to represent



Left: Mississippi has somewhat more black residents than white. *Center* It is in Arizona that we find the greatest proportion of Indians. *Right* In California where the yellow man is most seen he bears the ratio to the white residents indicated by a comparison of the two figures shown

The States that have the greatest proportion of non white residents of each category and how they show up on actual comparison

The relative proportions of the white, negro, Indian, and Japanese-Chinese population of the United States is indicated by the bulk (not the height) of these figures

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The World at the Crossways

IF a traveller from one of the planets were to light upon this world of ours coming with a mind free from prejudice and eager to learn the exact truth about us, and if the visitor were to pick up one of our school histories of fifty years ago, he would get the impression that the principal business of men had been that of fighting If he chanced upon Bernhardi's ridiculous book and read therein that war is a biological necessity he would doubtless exclaim "Exactly! The history of the people of this planet proves it!" Those of us who studied the school history books of the last century (we believe that they have been rewritten and are better balanced now) received the inevitable impression that down through the centuries fighting, military expeditions conquests and so forth, were the most important business of life, and that other matters were of subordinate importance Histories are better written today and such model work as Breasted's '*Ancient History*' gives a well proportioned and admirably balanced view of all the activities of our ancestors, not merely in war but in religion, social economy science and industry

Of all the breeders of war, ignorance and fear stand first. Ignorance breeds fear and suspicion Fear and suspicion breed war So it ever has been and, alas, so it is today Who was it who said that he could hate a man intensely until he met him, looked into his eyes, and held speech with him and then more often than not, his hatred was dissipated as a morning mist is thinned out by the morning sun? We take it that one of the most hopeful signs of the day particularly in international affairs, is the growing recognition of the 'get-together' idea As between man and man, we have practised it for centuries Now, at last, we are beginning to realize that it may be just as efficacious in the settlement of disputes between those aggregates of men which we call nations.

Today the nations are at the crossroads of history That is the meaning of the momentous call which our President (who grows daily in the confidence and esteem of his people) has sent forth to the great nations of the world We are among that growing number who believe that the conference which is to assemble on Armistice Day is destined to stand as one of the great milestones in the progress of humanity from ignorance suspicion hate and war to a state of peace, founded upon reasonable compromise and a regard for the fundamentals of justice

The keynote of this gathering will be struck by the United States, and upon the spirit and point of view with which we enter the council chamber will depend the success or failure of the whole conference It is absolutely essential that our representatives approach the forthcoming discussions with an open mind, also we must credit the other four nations with the same attitude

Nothing would kill the conference more effectually than a repetition of the recent fatuous talk about our rushing the 1916 program to completion so that we may enter the conference with the prestige of an unequalled battleship force behind us That would be fatal That would be to carry a "big stick" into the conference We would excite that very distrust and suspicion which President Harding has called this conference largely to allay

America is presented in this matter with a magnificent opportunity Let us say to the delegates "Gentlemen, we have come here, not to propose the entire abolition of armaments That would be impossible But we propose that the delegates here assembled make such a full, clear and honest declaration of their several aims and policies, that it will be possible so to adjust them, that our navies can be reduced to a mere police force, cooperating to make secure the high ways of the seas, and provide safe passage for all who may wish to come and go thereon."

The Use of Useless Things

PARADOXES are no doubt for the most part merely verbal They arise from incorrect or inconsistent use of words, or from misconceptions regarding their true and full meaning What things are useful? First, of course, the so-called necessities of life—food, clothing shelter Then, those things which alleviate pain or save endangered life the physician's kit of instruments and drugs And the list can no doubt be extended along this line, things as to the utility of which practically all are agreed

But what of amusements? Or higher in the scale of things what of art and science? Not technology and science as the handmaid of the 'useful arts,' but science as the goddess worshipped by her devotees without necessarily any thought of immediate or even of ultimate application

To the person devoid of musical ear and understanding surely a symphony orchestra must present a ludicrous spectacle A band of men, fifty, sixty or more, assembled on a stage, and going through meaningless motions for an hour or more at a time, producing an equally meaningless series of noises. And all this with a seriousness which would seem to call for some weighty circumstance as either its cause or its purpose Yet no such circumstance is in sight Surely the antics of the conductor are not sufficient to account for all these men behaving in this singular fashion And the audience Patiently and in silence they sit through the performance, and at the end return to their respective homes after having spent what must appear to our tone deaf friend a most unprofitable, a thoroughly wasted afternoon or evening

But what fundamentally, is useful? The things that make life possible? Yes—but only on one condition namely, that life be worth while Men have sought to justify the pursuit of pure science by its 'practical results', by the fact, clearly discernible in history that all scientific knowledge sooner or later finds 'useful application' no matter how far removed from industrial pursuits the cloistered academician may have started the spinning of the thread The seemingly most useless inquiries presently find their use, even in a crudely utilitarian sense

But is, really, any such advocacy any such defense of the pursuit of science for its own sake needed? The attitude of the mind which demands such justification, what does it amount to in the last analysis? It asserts nothing less than this That eating, drinking, sleeping, in short, the satisfaction of the primal needs are the warrant for all other pursuits In other words, that we live to eat

But, some will say, art, music literature these things appeal, if not to all at least to great numbers Pure Science, on the contrary, is the pleasure of a privileged few, of a highly exclusive aristocracy of intellect

This need not be so There is much of the fascination of science that can be communicated by the expert to an audience of lesser attainments as the virtuoso delivers his message from the Muse to the common mortal True, perhaps, that men of science have been somewhat neglectful of this obligation (for it surely is an obligation) to their fellows. Their work is very arduous and we cannot be very severe in our criticism of them in this matter Only, it does appear worth while to point out that they would undoubtedly find, for any efforts thus spent, a fitting reward in the increased appreciation on the part of the public, of their work and its products

And, granting that at the best the great, the deep pleasures of scientific discovery and contemplation are reserved for a few, is this really a disqualification for such pleasures to be weighed in the plea for the pursuit of science for science's sake? Is this a matter to be decided purely by numbers? If it should be found by count that Hottentots are the most numerous tribe on the face of the earth, should we therefore adjust all our doings and strivings to the Hottentot's standard of what is most worth while?

Surely the right standard to adopt in such matters is to be guided by that fine sense of values, that keenness of perception, that intensity of feeling which is the mark of the great. For it must ever be that the general average of excellence in a community is upheld and advanced by the exceptional few, the leaders in thought and deed, men in whom the flame of life burns fiercely, the light of reason glows undimmed

Natural Selection While You Wait

THE man who keeps his eyes, and beyond his eyes his mind open to what is going on around him, finds that life is full of things to speculate about In particular, he finds that the man made processes of civilization have a very immediate bearing upon the ordinary, unhindered acts of Nature—sometimes falling in in a surprising manner with her way of doing things, sometimes modifying her procedure in a fashion more or less pronounced but always interesting, and sometimes merely touching her in an unexpected spot.

In common with the porcupine, the turtle has been blessed by nature with a sort of immobile security that stands out sharply in distinction against the speed and the active fighting ability with which she protects most of her creatures against their foes, and on the other hand against the mere vast powers of multiplication with which she insures the perpetuation of her more helpless species. To confine our attention to the animal that is on our mind, it is conceivable that the turtle might be wiped out by a change of environment that would deprive him of food or subject him to unaccustomed temperatures. It is even imaginable that an active enemy might appear, capable of finding him with sufficient frequency and crushing him in a powerful jaw with sufficient effect, to make him ultimately obsolete or at least obsolescent. But it hardly seems reasonable to imagine that a systematic occurrence of the same accident could possibly catch up with the turtle often enough to destroy large numbers of this animal and to suggest that he may be on the way to ultimate extinction

Nevertheless, the turtle is today in the east at least succumbing to such a combination of circumstances in sufficient quantity to suggest that in the long run a definite result may be achieved upon the perpetuation of the species. During the past twenty years man has found it necessary to honeycomb the countryside with a network of hard strips of asphalt, brick, concrete and macadam. Over these roads there pass, at high speeds, juggernauts of a weight matched by few of nature's creatures, and by none in this part of the world Fast moving animals like the squirrel and the rabbit, possessing the instinct of flight from danger that accompanies speed are not affected by this what motorist ever achieved the running over of a rabbit? But the turtle, moving with extreme deliberation, and merely retiring into his shell in the presence of danger is in quite a different situation In a free state of nature, it would take the rare combination of a rock beneath him and an elephant or a land-slide above him to crush the life out of Mr. Tortoise, when he gets squeezed between a speeding car or truck and the hard road there is a different story to tell

This is by no means an idle flight of fancy Every eastern motorist must have noticed that in the spring and early summer, after a rain, the turtle, like the chicken, is possessed of a mania to cross the road On a three-mile drive we have counted as many as a dozen of them engaged in the hazardous procedure In the same distance we have counted the remains of four, marking the spots where drivers failed to see them or copied their refusal to dodge. We are sure that since the early spring of last March we have seen more dead turtles in the roads than live ones in the fields, woods and streams. If it is not an actual modification of the turtle's environment that is taking place, to his ultimate destruction, it is at least an interesting illustration, on a small scale, of the sudden and unexpected quarters from which such changes may fall, of the obscure causes which we must sometimes search out for the disappearance of past species, and of the rôle which man in his domination of the earth may play as an accelerator of nature's great game.

Electricity

Lightning and Radio.—In a recent severe electrical storm the Navy radio station at Arlington was struck by lightning and had temporarily to suspend operation. Men were at once set to work to put the plant back into operation, and the interruption was of short duration. No one was injured by the bolt.

A German Hydro-Electric Project.—The possibilities of large water powers along the Main-Danube Canal in Bavaria have been investigated and are set forth in a recent issue of *Elektrotechnische Zeitschrift*. The canal in its present form would yield about 100,000 horsepower, but with some additions and connections with other watersheds up to 1,000,000 horsepower may be obtained.

Scottish Water Power Schemes.—From the *Engineer* of London we learn that it is proposed to utilize the yield of a catchment area in the vicinity of Loch Laggan and Loch Treig in which the annual rainfall is probably fully 70 inches. The average available head at the turbines will be nearly 700 feet, giving an average development of 72,000 horsepower. The works will be constructed so that over 100,000 horsepower can be developed when sufficient water is available.

A Transmission Feat.—The Pit River hydro-electric development of the Pacific Gas and Electric Company of California will feature power transmission at 220,000 volts. This will be the greatest transmission line, from a point of voltage, which the engineering world has yet developed. It is reported that 10,000,000 pounds of bare copper cable will be used in this construction. The Pacific Gas and Electric Company's engineers have decided upon the use of a 500,000 cm 49-wire medium hard drawn cable made up of seven wire strands rope laid for the main power line, which will extend a distance of 180 miles, from the Pit River Falls to Cordelia, Calif.

Interesting Lamp Facts.—In the vacuum-type lamp the 40-watt size is used to the greatest extent, it representing about a quarter of all lamps of this class. The 25-watt is a good second, followed by the 60-watt and the 50-watt. A tendency to standardize the last named size accounts for a very perceptible increase in its use during the last two years. Meanwhile, continues *Electrical World*, the gas-filled lamps of 75 watts and 100 watts have risen in popularity, while little change is shown in the larger sizes. It now looks as if the two sizes just mentioned would very rapidly drive out the 100 watt and perhaps the 60-watt vacuum lamps. For street lighting work the vacuum type has virtually disappeared. The three voltages most generally used, including three-fourths of the whole number of lamps, are 110, 115, and 120. The use of the last two has grown at the expense of the first within two years.

St. Lawrence Project. — The International Joint Commission recently received the report of Col. W. P. Wooten and W. A. Bowden, the engineers appointed respectively by the American and Canadian governments to make a survey of the possibilities of canalization of the St. Lawrence as a means of shipping and the relation thereto of hydro-electric power. They report that the work would cost $250,000,000 and would result in the development of 1,700,000 horsepower at the ten locks planned. Plans are submitted for 25 to 30-foot depth waterways 120 miles long. According to *Electrical World*, four methods are suggested: (1) Locks and navigation dams in the river, (2) locks and side canals, (3) a combination of the two previous, and (4) by means of locks and power dams. The report recommends a combination of the four, declaring that the power so developed would pay for the entire project in a few years.

Tasting Radio Signals.—Two radio engineers, Alfred N. Goldsmith and Edward T. Dickey, have recently conducted a series of experiments with the object of determining the feasibility of reception of radio signals by the sense of taste. Electrodes were made which could be placed under the tongue in such a way as to cause a taste sensation when a source of potential was connected to them. Tests were made, using low potential direct current and 60-cycle alternating current, to ascertain the amount of energy and potential necessary for taste reception. The reception of actual signals from an antenna was tried. It was found impossible by using four stages of amplification to obtain taste sensations from all signals the audibility of which was greater than 500 in the detector circuit. The results obtained thus indicate that while from an electrical standpoint it is possible to receive radio signals by the sense of taste, the sense of taste is much inferior to that of hearing or even of sight, as a method of reception.

Science

Gondolas for the Thames.—Gondolas, those fascinating water taxis of Venice, are to be put into commission on the Thames. A local London builder is fabricating a fleet from real Venetian models. All the comfortable fittings will be provided.

Army Forts for Sale.—All the old Army forts which have not sufficient historic value and which are useless are to be sold by our War Department. These holdings are of no use to the Government. In fact, they are only an expense, and the land might just as well be turned into money.

A New Alberta Rye, Rosen, originating from seed imported from Michigan, and introduced by the Noble Foundation, has shown peculiar aptitude to climatic conditions here and will become a standard crop. It grows well in dry soil, outyields the ordinary varieties, and stands up well against frost.

Shackleton Again To Explore the Unknown. — Sir Ernest Shackleton is to make another expedition to the Antarctic, this time for more leisurely exploration than for a wild dash for the South Pole. His ship, the 'Quest,' is only 111 feet long so she can turn and twist in the ice. The scientific results of the expedition will be awaited with interest.

Military Tanks Check Heath Fires in England. — Military tanks are being used to check heath fires. All efforts to stop the flames near Aldershot failed until a detachment of tanks crawled out and the tank crews sprinkled water and chemicals on the fire and cleared the way for the fire fighters as though they were dealing with machine gun nests in Flanders.

German Toy Makers Coming.—Over eighty villages in Germany specialize in toy making and this local industry has suffered a great deal on account of insufficient foreign orders, while the expert toy makers are emigrating to England and are also getting to America somehow. Nuremburg is the center of the toy industry and this city is also suffering from lack of tourists, as toys and tourists are the two principal sources of prosperity by which the quaint old Bavarian city exists.

Government Guards Private Forests. — An agreement has been made by the Forest Service of the United States Department of Agriculture and a lumber company of California, by which the entire fire protection of about 800,000 acres of timberland owned by the company will be undertaken by the Government. The cost will be about $12,000 a year. This means that every precaution known to the Forest Service, both for preventing and fighting forest fire, will be used. Airplanes will patrol the timberlands and every forest ranger will be a fire warden.

Canadian Hemp.—A recent hemp "breaking" demonstration given at Winnipeg proved conclusively that hemp can be successfully grown in western Canada and that a machine has been invented capable of converting the hemp stalks into marketable hemp fiber which can be manufactured into practically anything from the coarsest rope to the finest linen. The demonstration was conducted by Col. William Grassie, D.S.O., president of the Canada Fiber Product Company and the hemp was grown at the Manitoba Agricultural College and lay under the snow all winter.

Irrigation and Drainage Education.—A course giving a general knowledge regarding irrigation and drainage has been added to the curriculum of the University of Alberta. The engineering aspects of irrigation will not be touched upon to any great extent, and the student's studies will be confined to the history of irrigation, kinds of irrigation, source of water, measurement and distribution of water, character of water used and its effect upon soil, crops, etc. No other Canadian educational institution has previously offered courses which covered the field of irrigation.

Progress of the Mount Everest Expedition. — The last report received via Simla under original date of June 10 outlines a tale of hardship and disappointment, which was what was to be expected. The transport service broke down early in the expedition, which hampered the explorers very much. Dr. Kellas did not recover from the hardships in climbing the snows and had to be carried in an arm chair by coolies, and he died suddenly while crossing a pass. He was buried on a slope overlooking Mt. Everest which he was so eager to climb. Everything is on such a gigantic scale that the human mind is appalled. Great precipices 7,000 feet deep are constantly encountered. The clouds are wonderful and the coloring of the landscape is beautiful. Nature's one last stand can only be conquered by the expenditure of blood and treasure, but the knowledge which is being obtained is worth the price.

Industrial Efficiency

British Columbia's Lumber Trade.—A good feature of the lumber industry in British Columbia during the month of June was the well sustained export demand, especially for the Orient. The June shipments to the offshore countries will total about 20,000,000 feet. These shipments have been destined to Japan, China, South Africa, Australia, New Zealand, Egypt, California, Mexico, Chile and Peru. Shipments to eastern Canada by water via Panama are a new feature of the business and will become regular if vessels maintain the run between Vancouver and Montreal, which depends upon the availability of cargo westward.

Pilfer Proof Packing Case. — The increase in the pilferage of goods in transit in the United Kingdom has led to the invention of a special packing case which is said to be pilfer-proof. Among other advantages claimed for it are: 1—The additional cost of construction is small. 2. It is 100 per cent stronger than ordinary cases. 3. As no battens are employed the shipping measurements are not increased, consequently a saving in freight is effected. At a demonstration before the London Chamber of Commerce a sample case is said to have resisted all efforts to get into it for 20 minutes and could not be reclosed without leaving very clear signs of its having been forced.

Alcohol as Locomotive Fuel.—From Pernambuco in Brazil comes the news that there are approximately 80 modern cane sugar factories, which have about 800 miles of railway, of from 0.75 to a 1 meter gage, operated at present by wood burning locomotives. The fuel problem, however, is becoming a serious one and as a result the sugar mill operators are turning their attention to reducing wood consumption and finding substitutes. Consequently great interest is being shown in the substitution of alcohol, which is produced in large quantities on the sugar plantations from the molasses finals. Pernambuco has recently adopted the use of alcohol to which 5 per cent gasoline has been added as an automobile fuel. There is considerable interest now in obtaining locomotives that can operate on this fuel.

From Harmonicas to Airplane Propellers.—Industrialists must do some pretty quick thinking and still quicker deciding in these uncertain days in order to keep their plants in operation, especially when trade is very slow. From Japan comes the report of an extreme case in industrial rearrangement to take care of abnormal conditions. A Japanese company manufacturing pianos and organs had to be turned into an airplane propeller factory. It is understood that this factory, in addition to the manufacture of pianos and organs developed since the outbreak of the war a large export business in harmonicas, chiefly from the United States. In recent months it has encountered such formidable competition from German goods said to be better and cheaper that it decided to initiate this new business.

Training for Ex-Service Men.—The British Ministry of Labor has had good results in the training of disabled ex-service men. At present there are fifty ex-service men in training in the following rural crafts, at one of the many Government instructional factories: 1—Woodworking including vehicle repairing and farm and estate carpentry. 2—Metal working including smithing, agricultural implement and motor tractor repairing. 3—Leather working trades including saddlery and the repairing of harness. This is but one of the numerous instructional factories throughout the United Kingdom. Most, if not all, of the workers are suffering from some disablement. There are over 100,000 ex-service men in training at these factories in various parts of the country and there is provision and accommodation for 200,000.

Germany's Opportunity. — Whatever may be the political outcome of the Peace Treaty, one thing is certain and that is the advantage enjoyed by German industrialists and traders at this time. Relief from huge naval and military burdens, together with the low value of the mark abroad, enables German manufacturers to introduce their goods in foreign countries at prices that defy competition. Indeed the manufacturers of England, France, Belgium, Italy, the United States and even Japan are in many instances helpless in the face of German competition. As long as Germany sells, she gains by the exchange. Her industrialists are seeing to it that they are generally the sellers and rarely the buyers, since when they buy the exchange works against them. Most German products at present are made from strictly German raw products. As for the Allied export tax, the German industrialists simply charge that much more for their products which are still low enough in price to compete with those of other countries.

Painting with Metal Spray

How Protective Coatings Are Shot Into Place Under the Latest Procedure

By Robert G. Skerrett

ELECTROPLATING and galvanizing are well proved and widely applied processes that have many fields of usefulness. Indeed, they would be resorted to far more extensively if there were not conditions that make this prohibitive. That is to say, many metal articles might be plated to advantage if their basic substances could resist the while the corrosive attack of the electrolyte employed, and the size and structural get-up of other metallic bodies are such that it is commercially impracticable to provide a zinc bath large enough to admit of their treatment.

Nevertheless, metal coatings have been devised that are handled more or less like paints, and to a point these have served fairly well although admittedly not as durable or satisfactory as the shielding film deposited electrically or by dipping in a bath of molten metal. The fundamental weakness of these painted-on or stuck-on coatings has been the lack of intimate union between the underlying and the attached metals. However, years of scientific research and inventive cunning have finally brought to a truly commercial stage a flexible system which makes it possible to form a covering film by spraying melted metal upon a variety of surfaces for protective or decorative purposes. In this the achievements of M. U. Schoop, of Zürich, Switzerland, are conspicuous.

The SCIENTIFIC AMERICAN has previously described the Schoop process—the last article appearing a little over six years ago. Since then this ingenious engineer has pushed steadily onward, improving the while earlier apparatus and creating still newer instrumentalities that add greatly to the capabilities of his spraying method. For a time Schoop relied upon an oxy-hydrogen flame either to melt powdered metal or to fuse a wire which, while in the molten state was atomized by a stream of compressed air and driven at considerable velocity against the surface to be coated. Now, he employs an oxy-acetylene jet, and this has proved quite 50 per cent superior. The higher temperatures obtained in this way insure better results, give the metal coating pistol a longer effective range, and make it feasible to handle efficiently metals differing widely in their melting points.

A few years back the somewhat delicate mechanism that fed the wire into the flame of the blowpipe was operated by a small pneumatic turbine which made about 28,000 revolutions a minute. This meant that a rather complex reduction gear was required in order to transmit a far more sluggish movement to the fusing wire. The commercial demand was for a pistol of really rugged construction which could be entrusted to the average workman and his commonly unskilled manipulation. To this end a pistol has been produced which is equipped with an air-driven Pelton wheel which makes between 4000 and 5000 turns a minute. The wire-feeding feature is, in consequence, now reasonably robust, and the speed adjustment of the feed is simplified to a marked extent.

But probably the greatest step forward has been in the substitution of the electric arc for the gas flame. In the "Electro-pistol," which functions with either direct or alternating current two wires, moving toward each other, form part of the circuit. The two free or open ends of this circuit are brought together and then separated just far enough to induce an arc and this distance is maintained as the wires are uniformly fed into this arc and fused. At the same time the melting terminals are swept by a jet of compressed air, and this atomizes the metal and drives the plastic globules against the surface to be coated. The temperature of the arc is higher than 5400 degrees Fahrenheit and, therefore, sufficient to permit the melting and spraying of platinum, molybdenum and other very refractory metals.

The electro-pistol weighs only 3.3 pounds, uses 40 amperes of current at from 25 to 30 volts, and calls for an expenditure of 17.6 cubic feet of compressed air per minute, which is supplied at a pressure of 3 atmospheres. In this connection it is interesting to note that Schoop has found, in the course of his developmental work, that it is not essential to employ an air impulse of very high pressure to get a spray fine enough for his purpose and to propel the metal particles a suitable distance from the pistol to the object to be treated. Originally he experimented with pressures ranging from 35 to 40 atmospheres, and these he stepped down to 12 atmospheres with which he practised for some time. Later on with proper facilities, air at 6 and 7 atmospheres answered. At present there are in service many hundreds of his various types of metal-spraying pistols that are operating satisfactorily with an air impulse of 2½ or 3 atmospheres.

Transmission towers and spreaders for the Swiss electrified railways, which were galvanized by the spray system

Ten years ago the efficiency of the Schoop-spraying apparatus was comparatively low, for then, of the total volume of metal heated and sprayed, only 30 per cent was deposited, the remaining 70 per cent being dissipated in the atmosphere and in a way to interfere with the breathing of the operative. The pistols now in use are able to deposit 90 per cent of the metal atomised, and in the case of aluminum the factor of efficiency is 95 per cent. In the past only tin, lead, and zinc could be handled, but the list of metals that can now be precipitated by the process is a far longer one—in fact, it includes any that can be fused by either the oxy-acetylene flame or the electric arc.

A terra-cotta box that has been bronzed by the spray method

In 1912 Schoop demonstrated that it was feasible to melt, to diffuse, and to deposit enamel, glass, quartz, etc., on suitable bodies, but he elected at that time to devote all of his energies to the problems relating to metal spraying. Within the past year, however, he has again taken up enameling, and his accomplishments open up new avenues of application for his broad system. Even when silicate of lead is added to reduce the melting point of enamel or glass, still temperatures ranging from 1112 degrees to 1292 degrees Fahrenheit are necessary, and it is therefore practicable to coat only materials that can withstand exposure to that heat without injury. The surfacing substance may be in a powdered or granular state or it may be in some other form which is not so readily fused. Care has to be taken to see to it that the driving medium, compressed air or inflammable gas, shall be so controlled that it will not exert a troublesome cooling effect before the vitreous material has reached the object to be covered.

It seems that by the admixture of coloring matter it is possible to give the enamel or glaze any desired tint, and there is reason to believe that this new evolution of the process can be used to advantage both in the field of art and in many departments of industry. The glaze or enamel imparts a brilliant and beautiful finish, according to the composition. Not only that, but the coatings are of a pronounced refractory character. Indeed, tests have repeatedly revealed that tin and other metals so enameled can be heated to redness in a Bunsen flame and then plunged directly into cold water without causing the film to peel off or crack.

As the Schoop system stands at present, the spraying pistols are of three types and, whether the heating agency be oxy-acetylene gas or electricity, they render it feasible to deal with powdered metal or wire or vitreous substances. Each pattern of pistol has its virtues, and, therefore, is able to meet special requirements or conditions. These several apparatus may be operated from stationary or portable plants. The portable equipments are

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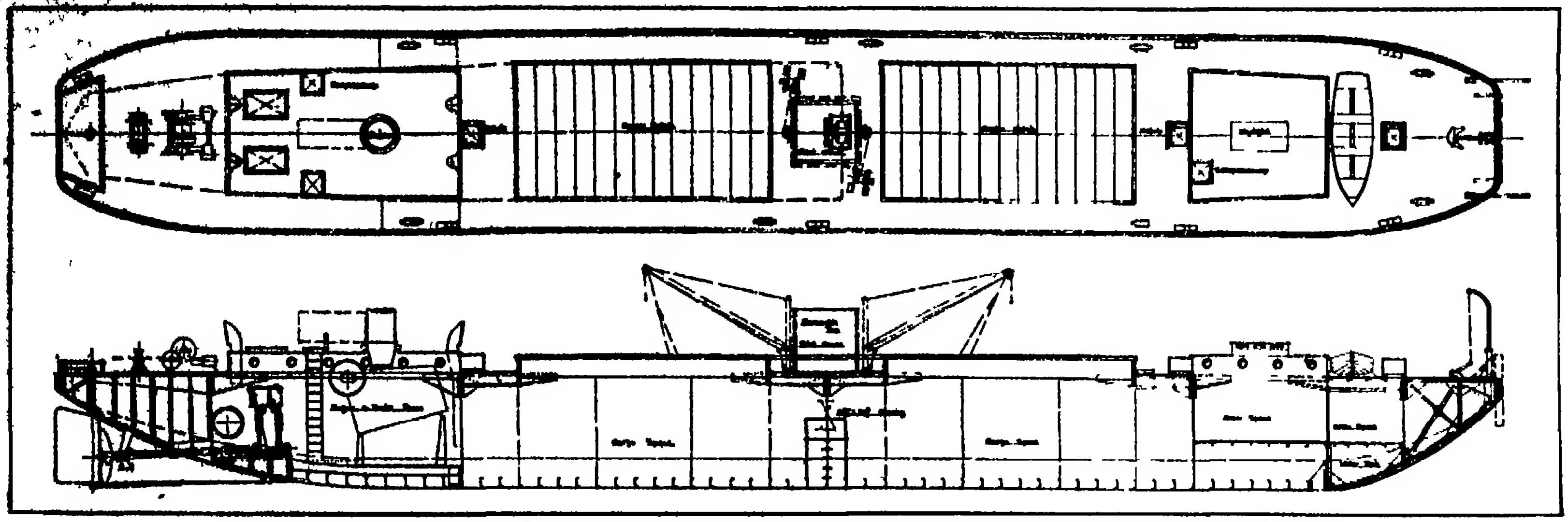
A portable plant for the operation of the "electro-pistol," making it possible to deal with structures heretofore inaccessible



Plan and sectional view of one of the new Government-built barges to be employed on the New York State Barge Canal

Self-Propelled Steel Barges for the State Barge Canal

WE present drawings showing the characteristics of the twelve self-propelled steel barges, which the United States Government built recently for service on the New York State Barge Canal. We confess to a liking for these craft, they should prove to be well adapted for their particular work. They are intended to serve as tow boats, handling from three to six barges, and to be able, themselves, to carry about three-fifths of the load of a non-propelled cargo barge. Three of the cargo barges in consort with one of these tow barges will be able to pass through the canal in single lockings.

The general dimensions are: Length overall, 150 feet, beam, 20 feet, depth, 12 feet. The hull of the tow barge is similar to that of the steel cargo barges, of which there are 51, the dimensions being the same. It should be mentioned that the construction of all these barges is very rugged, with the expectation that they will be operated in Long Island Sound, New York Harbor, Hudson River, and Chesapeake Bay, during the winter months after the close of navigation in the Barge Canal. They could also be transferred, coastwise, to other waters if it should be so desired.

The fore peak of the barge forms a single reserve feed water and trimming tank of 7050 gallons' capacity. Abaft the peak bulkhead and under a steel trunk is a space 22 feet long extending the full width of the vessel, which is devoted to crews' quarters and is certified for twelve seamen. It is divided into mess room, two officers' double staterooms, galley, toilets, showers for both officers and crew, and a forecastle with berths for eight men. Then, going aft, we find two 38-foot cargo holds with a 14-by-26-foot hatch over each. Abaft of these is the machinery space, 26 feet long, under a well-ventilated steel trunk. A fuel-oil compartment 12 feet long, divided longitudinally into two tanks is located in the after end of the vessel. The combined capacity of the tanks is 12,300 gallons. The pilot house is located amidship. It is built in two sections, so that the upper half may be removed in exceptional circumstances, to give clearance under low bridges.

Two portable steel derricks of 500 pounds lifting capacity are placed one forward and one aft of the pilot house. Leads from the derricks run to two 8-by-4, double-cylinder, single-drum winches on deck near the pilot house. The smokestack is arranged to hinge back on the engine trunk.

An 8-inch by 10-foot, double-cylinder, single-drum winch is located abaft the engine room trunk for towing and warping.

The double propellers are four blade cast iron. Two balanced rudders are provided and the tillers are yoked together so that their operation is identical and simultaneous.

The tow barges are driven by vertical fore-and-aft compound engines, and steam is supplied by a water tube boiler at 225 pounds' working pressure. The net cargo capacity is 300 short tons on a mean draft of nine feet in fresh water. The estimated speed of the vessels in light condition is ten knots.

A Few Facts and a Little Fancy

THAT iron is stronger than wood seems too self evident to warrant consideration, yet flywheels are often constructed of wood because they can be run at a higher speed than iron without danger of bursting. The mathematical explanation of this apparent absurdity lies in the fact that the stress tending to burst the wheel increases with the weight and the square of the velocity. The velocity at which the wheel will burst is therefore dependent on the square root of the strength divided by the weight. As the strength of maple wood, for example, is 10,500 pounds per square inch and its weight only 0.0283 pounds per cubic inch, giving a quotient of 371.024 while the strength of cast iron is 20,000 pounds per square inch and its weight 0.26 pounds per cubic inch, giving a quotient 76.923, it follows that so far as strength and weight of materials is concerned maple flywheels will stand a speed approximately the square root of the ratio of these two quotients or about 2¼ times greater than cast iron wheels. Even when the greater difficulties of designing and constructing wooden wheels, necessarily made of a large number of comparatively small pieces of wood are taken into account they may be so designed as to be operated safely at a speed 50 per cent higher than that of cast iron wheels.

The speed of flywheels is often as high as a mile a minute and in some instances nearly three miles.

It is difficult to realize the amount of energy in a rapidly revolving flywheel because it does not appear to move. If, however it is possible to imagine one of these wheels thirty feet in diameter weighing many tons, rolling along a city street at from one to three times the speed of the fastest express train, it will not require a much greater stretch of the imagination to grasp what would happen if it encounters a factory building in its path. Its destructive power, however, will be no greater than that of a bursting flywheel of the same size and revolving at the same speed.

To turn all of these flywheels boilers containing still greater stores of energy are required. It has been estimated that every cubic foot of water in an operating boiler contains as much pent up energy as a pound of gunpowder. The explosive effect of even a comparatively small boiler such as is used for power purposes would, on this basis, be equal to that of about 200 pounds of powder which would be sufficient to project the boilers to a height of about two miles.

With all these deposits of pent up energy around us, in the factories or office buildings where we work in the hotels in which we dine the apartments in which we sleep and under the sidewalks on which we walk, it may be excusable for us to allow our usually well behaved imaginations to picture for us what a glorious event for a Fourth of July celebration it would be for all of the boilers and flywheels now industriously engaged in making the commercial and industrial world move, to go on a strike so to speak or better still decide to start out for themselves.

Left: One of the steel, self-propelled barges for the New York State Barge Canal. *Right:* Deck view of steel barge, looking forward, showing the removable pilot house and one of the two portable steel derricks

Housework in the Laboratory

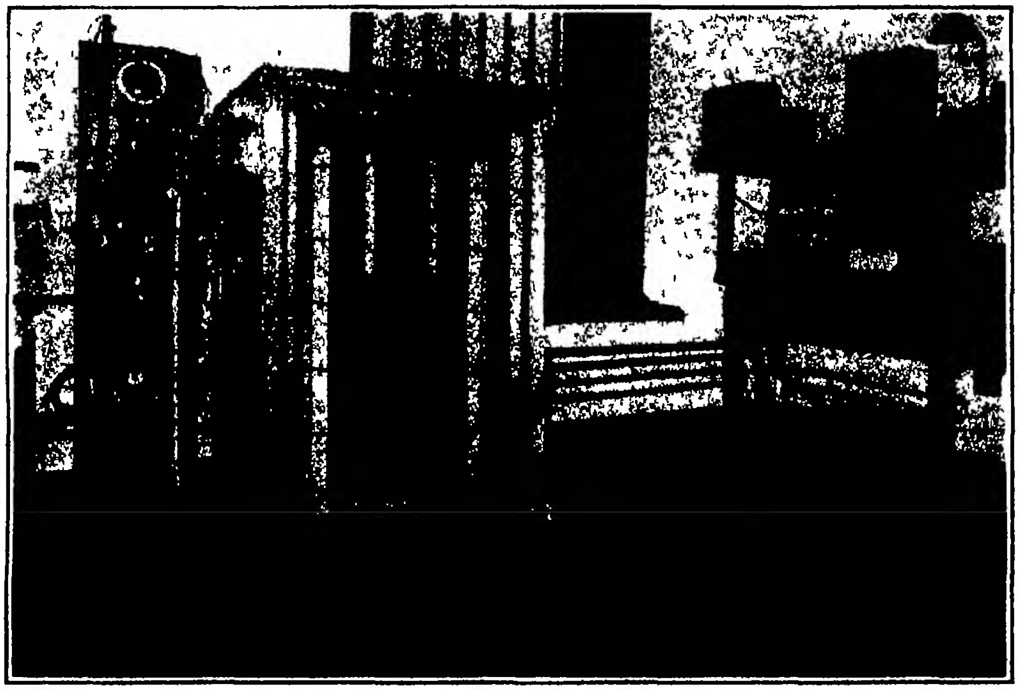
What the Government Tests Have Revealed Regarding the Energy Expended by the Housewife in Her Daily Work

By S. R. Winters

SOMEBODY who sympathized with the drudgery of the housewife voiced the sentiment that man worked from sun to sun while woman's work was never done. Irrespective of the literal truth of this poetic expression, the variety and frequently irksome tasks incident to the care of the household are not to be gainsaid. Knitting, washing, ironing, sewing, crocheting, sweeping the floor, dishwashing and dressing infant members of the home, are duties that entail a varied and specific service. The labor required for each task is not measured by the worker, the energy expended during the day perhaps being roughly computed in the implied or expressed feeling at bedtime, "I am tired."

The variations in the energy expended in manipulating a 5-pound iron, scrubbing a floor, knitting a sweater at the rate of 23 stitches a minute, rubbing a towel on a board 40 times in 30 seconds, washing dishes, dressing an infant, and other manifold household duties, comprise a subject which is interesting to contemplate in its details. Or, even more stimulating to the imagination and thought provoking is the comparative study of the energy dissipated when a woman is comfortably resting in a swivel chair and the caloric requirements when lending herself unreservedly to the tasks of the household. This hitherto speculative subject, in its many ramifications, has been translated into the realm of scientific knowledge by a series of 53 experiments recently concluded by C. F. Langworthy and H. G. Barott of the Office of Home Economics, United States Department of Agriculture. A woman subject and a specially-constructed mechanical equipment were employed in negotiating the novel study, in which age, size, sex and occupation, are influential factors in the variations of energy expenditure.

The principle of operation recognized that variations in the change of energy in the body are attended by corresponding variations in the heat output. In consequence the expenditure of energy by the body was computed from measurements of the heat produced. The machine to which the woman under study submitted herself is technically described as a respiration calorimeter. The original design was modified, the change involving a reduction of the size of the apparatus in the interest of reliability in measuring the oxygen consumed by the subject. Also the mass of metal in the structural framework of the equipment was removed inasmuch as its presence introduced difficulties in obtaining accurate information relative to heat conditions of the chamber whenever any change was authorized in the activities of the woman subject. The respiration calorimeter, in brief, consists of a chamber 75 x 120 x 200 centimeters in dimensions, having air tight walls. The machine is coupled to devices for maintaining a current of air through it from which the water vapor and carbon dioxide eliminated by the woman under examination can be removed. Equipment is likewise available for conveying away and measuring the quantity of heat produced within the chamber. The woman submitting herself to the observations remained in the caged in outfit during the experimental period, resting in a swivel chair or performing a specific household duty as the plans might prescribe. A comparison of the amount of energy transformed by the body during a specified time while at complete rest and while doing the allotted work was assumed to be the requirement of energy for the execution of the task at hand. Direct measurements of the heat produced by the body were determined.



Respiration calorimeter employed by the Office of Home Economics, Department of Agriculture, in determining the energy expenditure in performing household tasks

Since age and size are among the factors influencing variations in energy exacted in the performance of household tasks, it is permissible to reveal the age of the anonymous subject. She is 22 years old, thin and spare in build, 5 feet 4 inches tall, and weighs 110 pounds in uniform. Her weight was determined at the conclusion of each of the series of 53 experiments. Her attire consisted of a "middy blouse," a skirt of cotton, and underclothes light in weight. The experimental period was of two hours' duration, beginning at approximately the same time each day as observance in the interest of uniform physiological conditions. The subject was deprived of breakfast, other than one cup of cocoa made uniformly of half a pint of cream, two teaspoonfuls of cocoa, and one teaspoonful of sugar, the hour of consumption being 7:30 in the morning. She entered the respiration calorimeter at 10:30, and measurements were begun between 11 and 11:30. While hemmed in by the apparatus she submitted unerringly to the particular program of work, the tasks being performed to the beat of a metronome, an instrument which accurately counted the number of movements. Typical household responsibilities were included in the tests, the results of which are applicable in determining the strength exacted of the housewife in the execution of similar duties. Strange anomaly, it would seem, that clothes were washed in the absence of water. The presence of water, however, would have exercised a complicating effect on the water vapor and heat measurements in the calorimeter. Other experiments were conducted in orderly procedure.

Instead of toiling and then resting, the subject took advantage of an opportunity and remained at ease in a comfortable swivel-chair at the outset of the experiments. Her inertia during four tests of two hours each is suggested by the statement that she hardly moved—quietness reigning supreme. The number of calories measured in each of the series of experiments was uniform, being 121.4 for the two-hour period or 60.7 calories expended each hour. The value of the heat output when the subject rested was that of forming a basis of comparison with results obtainable in the performance of work. The less arduous tasks of sewing, crocheting, knitting, darning and embroidering involved an expenditure of 9 calories an hour in excess of the heat output when the woman subject relaxed unreservedly in a swivel-chair. Washing, sweeping, and scrubbing floors, represented as the more laborious activities of the household, exacted an increased energy requirement of 50 calories compared with the expenditure when the woman was at rest.

The inadvisability of submitting a baby to such an unseemly test to determine how much energy mother squandered in caring for children was an obstacle surmounted by use of a counterfeit infant. Dressing and undressing a full-sized model, comparable to a year-old infant, afforded data in this particular. A mother of a year-old boy, as Shakespeare would say, "mewling and pewking in the nurse's arms," will appreciate the fact that in this experimental laboratory of make-believe the model was dressed and undressed seven times within two hours. Its clothing consisted of a band (no sleeves), diaper, shirt with sleeves, two undershirts (no sleeves), dress, knitted sack with sleeves, socks, booties, and bonnet. In terms of sweat of the brow, the fondling mother of this substitute baby expended 23.0 calories an hour for work alone. The figures are lower, undoubtedly, than the requirement in caring for a living child. The model weighed only 2 kilograms whereas a child of the size of the dummy would weigh 8 or 10 kilograms. Accepting the heat output of 23.0 calories an hour as approximately correct, the energy expenditure was twice as great as that entailed by sewing, similar to the requirements for dishwashing and ironing, and one-half that for washing clothes. Mothers, suffering from a storm tossed house where boys romp at will, can subscribe to the sentiment of the Office of Home Economics that caring for children is a "moderately heavy household task." I suspect that the statement could be stretched and still remain within the bounds of truth.

Sweeping and washing floors, the bugaboo of housework, were conducted in the experimental laboratory with efforts aiming to duplicate those involved in actual practice. Sweeping was done on the bare floor, a long handled broom being pushed forward, lifted, and moved back. Thirty-eight complete strokes were made each minute. In the absence of water, the floor-washing experiment involved the use of a dry cloth and empty pail. The woman, on her knees, administered 85 short rubs of the cloth on the floor in 50 seconds and wrung the rag in the pail for 10 seconds. Forty calories an hour were utilized for the work alone, indicating that this form of labor is four or five times greater than that of knitting and sewing. The 29 calories an hour for energy expenditure in floor washing is considered too low. The omission of water, thus relieving somewhat the burden of lifting and wringing the wet cloth, as well as the inexperience of the woman subject in this form of work, are circumstances for consideration in accepting the results of this experiment.

Dishwashing, a subject which constantly solicits inventive genius to devise a practical machine for the specific undertaking, was negotiated at tables of varying heights. One table was too low for comfort, another, excessive elevation was objectionable, while a third was gaged at a correct height. The low table was 65 centimeters from the floor, the high one was 100 centimeters, and the table whose height was suitably adjusted was 85 centimeters and the top of the pan 98 centimeters from the floor. The dishes, consisting of four plates, two bowls, two teacups, and two saucers, were placed in a pan, rubbed with a cloth, placed in draining pan and then wiped. Each dish rubbed ten times, turned, and given ten more rubs, in time with a measuring instrument, beating 180 times a minute. Ten beats were allowed to change dishes. The process was repeated twelve times per hour. With only 24.8 calories expended each hour, washing table dishes is classified as moderate toil, about midway be-

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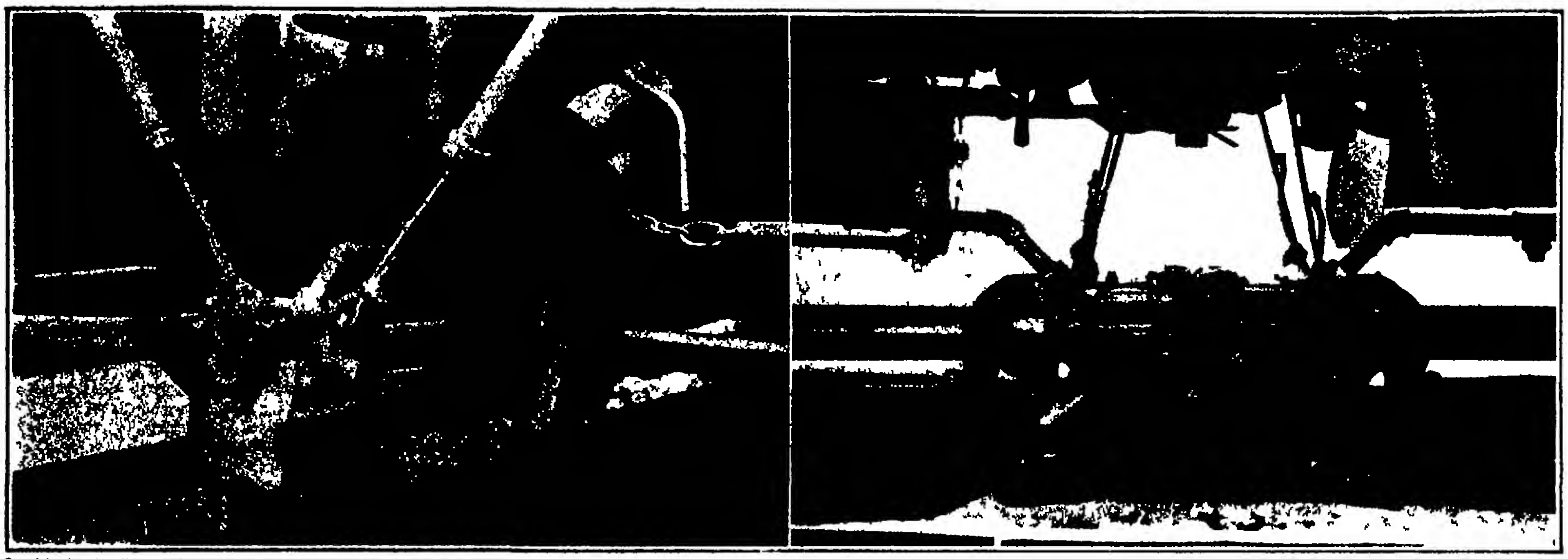

Two views of the Futrell automatic coupler which connects the steam, air, signal, electric light and telephone lines on trains without manual aid of any kind

Simplifying the Coupling of Trains

DURING the past twenty five or thirty years the railroads of this country have been seeking a substitute for the old method of connecting by hand the rubber hose lines between railroad cars and coaches. These couplings are made after the cars are brought together on the draw bar.

As a rule it is the duty of the brakemen to attend to these connections. At the risk to life and limb they must crawl beneath the ends of the cars and fasten the hose. Accidents have often happened while the men performed this duty. Sometimes the men would slip on the wet or icy rails while the train started, and the net result would be that the victims would either be ground to death under the wheels, or they would have arms or legs cut off and be maimed for life. There are also cases on record where the railroad men have been crushed between the heads of the draw bars while attending to the rubber hose connections.

The old system of coupling cars means also the waste of a lot of time, since a brakeman very often has to walk the entire length of a long freight train in order to couple up a single car.

Railroad men are familiar with the difficulty of preventing rubber hose from leaking. Leaks will occur at some time or other and even new hose is not always proof against a leak. This means that there is difficulty in maintaining sufficient steam for heating purposes in all the coaches of a passenger train. While the coaches nearest the locomotive are warm and comfortable, the rear coaches are cold. And there are kicks and complaints coming from the passengers. Furthermore, should the hose that operates the air brakes spring a leak, some disastrous results might follow. Perhaps a collision is imminent and the engineer may not be able to stop his train in time to prevent the loss of lives and property. The extra pumping a locomotive must do in order to maintain a sufficient air pressure against faulty joints necessitates the extra consumption of from 100 to 300 pounds of coal per hour. Here is wastage which runs into millions of dollars annually.

It is figured that at the present time there are in the United States about 2,500,000 passenger and freight cars and about 66,400 locomotives. If we figure the average life of hose at eight or nine months, and do not consider the losses due to careless treatment, with something like five or six million lengths in service, the annual renewals will number in the neighborhood of 9,000,000 pieces. At the present cost of hose this means an annual expenditure of close to $10,400,000. Obviously, there is room for improvement here, and several attempts have been made in the way of automatic car couplers, some of them being described in these columns in the past. We now have a new automatic coupler to consider.

Some years ago a railroad conductor by the name of Thomas J. Futrell, formerly of Seattle, Washington, but now of Streator, Illinois, saw the necessity of an automatic coupler to take the place of the old system of using rubber hose and connecting it by hand. Mr. Futrell has had nearly thirty years experience in the railroad service, and from this one might draw the inference that he is familiar with the needs of the service. He determined to make a device that would be a time, money and life saver. After several years of labor, which meant many experiments, he finally attained the results he was after in the form of the automatic coupler shown in the accompanying illustrations at the top of the page.

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Sucking the Cargo Out of a Ship

MECHANICAL loading and unloading devices are an old story now, but the photographs herewith show a new angle of this interesting work. At Oakland, Cal., and at New Orleans, and doubtless at other points which have not come to our attention, pneumatic handling of bulk materials is now the order of the day, and these are taken out of the ship's hold or put in without being touched by hand, shovel or other instrument. The air pipe sucks the cargo out of the hold, carries it to the freight car, and packs it securely and tightly for its overland journey.

The machine consists in the first place of two pipes that go down into the interior of the ship. These run to the top of a small building on the pier in which are located the motors that supply the suction. These suction pipes lead the grain to the mouth of a second set of pipes which blow instead of suck, and through these it is forced out into the waiting car. So tightly does the blast force the grain into the space provided for it that the carrying capacity of the car is increased twenty per cent. Thirty tons of wheat per hour is the rated capacity of the Oakland installation.

At New Orleans the suction device is installed in connection with the public elevators, which we have already mentioned in these columns. It would appear from the photograph that this installation leaves something to be desired in that it seems necessary for the grain to be assisted to the mouth of the pipe by men with shovels.

While the primary intent of the new system is the handling of grain, it is available for numerous other cargoes. At Oakland it has been used, among other things, for copra, which comes in fairly large pieces, so its range is wider than might appear. Doubtless it would be available for small sizes of coal.

The suction unloader as seen on the pier at Oakland, and in the hold of the ship at New Orleans

Winning Foreign Film Markets

How the American Motion Picture Industry Is Acquiring a Firm Footing in Other Lands

By O. R. Geyer

> *THE American motion picture industry has become infected with the new spirit of internationalism which has taken such firm root in the economic and industrial life of the country as the result of the seizure of war-time opportunities Already the infant industry has definitely embarked upon a program of world-wide expansion and exploitation which is destined to eclipse the golden era now recognized as one of the great industrial romances of America This is the story which Mr Geyer, in close touch with the developments, has to tell us on this page* —THE EDITOR

THERE is no greater industrial romance than the spectacular development of the film business in the United States in the last few years Fewer than ten years ago critics were about evenly divided as to the future of the screen which was just beginning to make its influence felt in an adolescent way in the amusement world *Today the film industry is serving 16,000* American theaters and is doing business which will aggregate $1,000,000,000 during the present year

Another ten years will see the American films as firmly entrenched in world markets as today in America, and in the face of the most severe competition with British, French, Italian, German and Scandinavian producers and exporters. When this time comes the leading American companies will be serving 50 000 or more motion picture theaters scattered throughout every country in the world, and unless all signs fail, will be entitled to a position in the class of industries doing an annual business of $2 000,000,000 or more

*An illustration of the progress made in this direc*tion is to be found in the fact that the American film exporters have increased their business by more than 300 per cent in the last three years and, as yet, have made a very small dent in the foreign business awaiting development An expression often used in recent years in connection with the development of the domestic business, "scratching the surface," now is applicable to the business being done in foreign fields One of the leading producers and exporters of films increased its foreign business from $1,000,000 to approximately $5,000,000 in three years time despite the restrictions placed *upon commerce by the war* The present year will see another $2 000,000 or $3,000,000 in increased business for this one corporation alone Add to this the enormous export business being done by other leading American concerns and one may gain an idea of the great progress made by this infant American industry in its invasion of foreign fields

Practically 95 per cent of this business has been developed in Great Britain Western Europe and South America The business now held in this portion of the *globe is capable of vast expansion, for it* is only in the last two years that American films have gained first place in these markets. More than three fourths of the South American territory is awaiting development and it can truly be said that the markets *of Western Europe have only been subjected to surface* explorations

The great potential markets of Africa Central America, Australia, Central and Eastern Europe and Asia have yet to be opened on anything approaching the scale attained in other fields Steps already have been taken for the exploitation of these fields and the next few years will witness a surprising increase in the development of this youthful export industry Because of the tremendous prestige gained by American pictures during the war, this country holds first place in the race for these markets

China, with its 400,000 000 population and fewer than three score *picture theaters*, India, with its 300,000,000 and limited number of theaters Africa, practically a virgin field Russia Germany, Siberia, Western Asia, Japan and Australia—all these offer unlimited opportunities for the expansion of the film export business, and it is to these countries that the leading American concerns are now beginning to turn their attention. In order to attain the highest possible development in these countries, many thousands of theaters must be built, and hundreds of millions of dollars will be required to finance these operations. This capital will come from the leading bankers of America and Europe who within the last twelve months, have shown a dis*position to embark heavily in such enterprises*

As one of the first steps in this program of development and expansion, some of the principal American companies are engaged in building and projecting large studio enterprises throughout the world One American company has just completed a mammoth studio in London, in which British and American capital is interested Production work has been begun and will be increased until it is conducted on a large scale This company has also announced plans for the erection of a similar studio in Bombay, India, and within the next year or two will have studios in operation or building in France, Spain, the Scandinavian countries, Belgium, Switzerland, Poland, *Italy*, Czecho-Slovakia and possibly Germany

Within a period of five years the building and operating of studios will have been extended to the principal South American countries, Russia, the Balkans, Egypt, *South Africa, Asia Minor*, China and Japan and such other territories as are found to be ripe for the inauguration of American producing activities. This activity is not confined wholly to one company, as other concerns have announced plans for the erection of studios in Great Britain, unanimously held to be the first stepping stone in this plan of world-wide development Individual stars and producers are making arrangements to visit Europe for the making of occasional pictures, and these activities doubtless will be extended to other countries having a well-developed motion picture patronage

In so far as possible local artists will be employed by *each of these studios, although Americans will be* placed in charge and American methods of production used throughout. American artists will be used for the production of individual pictures, or generally in those countries which have not developed the required dramatic talent These studios will be utilized in developing mechanical and artistic experts as a concession to national sentiment The stories of the foremost writers of these countries will be filmed on the locations actually described, which means an end to the day when foreign locations will be obtained in and around the Los Angeles studios. This is an innovation which will prove of great value in increasing the prestige of American made pictures abroad, as inaccuracies in the details of costuming or locations find ready critics in all countries.

Strange as it may seem, a large amount of European capital is finding its way into these American ventures It is quite well known that many millions already have been invested, and that tens of millions of additional capital will be ready as soon as more normal conditions are restored throughout the world Leading financiers in Wall Street and other large American financial centers are heavily interested in the extension of producing and distributing activities abroad It is estimated that several hundreds of millions of dollars will be required for the building of studios, erection of theaters and the providing of increased facilities for the foreign distribution of these pictures It will be comparatively easy to obtain this vast sum, however, as capitalists have heard of the vast profits to be obtained from the production and distribution of high-grade pictures It is also apparent that the industry has passed the promotion stage and is now firmly entrenched as a legitimate business enterprise

An event of unusual importance in American film circles will be the opening of Germany and Central Europe to American pictures, an event whose exact schedule depends upon Germany's ability to begin the settling down process. This territory, which includes Germany Austria, Hungary Czecho-Slovakia, Jugo-Slovakia Rumania, Poland, the Ukraine and Bulgaria, has been without American pictures for more than six years, and the masses of people are totally ignorant of the tremendous progress made in the film industry in the years they have been at war Except for that portion of the Rhine territory occupied by Allied troops, no American films have been shown in Germany since 1914. A population of approximately 200,000,000 and 8000 motion picture theaters, offer the possibilities of rich rewards for the producers and distributors of high grade American pictures in Central Europe

Arrangements are under way for the opening of the Asia Minor territory for the exploitation of American photoplays This, too, is virgin territory, inasmuch as motion pictures were practically unknown prior to *the latter years of the war* Bagdad, the Euphrates Valley, Jerusalem, and the valley of the Jordan were scarcely aware of the existence of the modern motion picture until Y M C A. secretaries arrived in Asia Minor to provide entertainment for the British and Allied troops. Natives gained admission to some of these shows and immediately acquired the movie habit. Bagdad now has three theaters and will have many more within the next year or so.

The Arabs, Kurds, Turks and other nationalities in Western Asia derive a vast amount of pleasure from the modern film, provided it carries no features offensive to the teachings of the Koran. Grunts of delighted approval greet the deeds of daring of the cowboys and rough and ready men of the West as shown upon the screen. Kisses and the highly colored romanticism of the cheaper films are not enjoyed and are taboo. There are many large cities in this territory barren, or practically so, of motion picture houses. Teheran, the capital of Persia and a city of 70,000 has yet to experience the delight of its first film theater The signing of a commercial treaty between Persia and Great Britain has opened the way for the exploitation of this field through enterprises controlled jointly by British and Americans, and it will not be many *months before a highly prosperous motion-*picture business has been organized in this vast territory

As soon as Russia returns to peaceful pursuits American companies will be ready for the development of another great virgin territory Except in a few favored localities no American pictures of a high grade character have been shown in Russia since the war began. A prominent company operating abroad extensively has completed arrangements for the opening of the Russian territory as *soon as normal conditions are restored.*

One obstacle in the path of the world wide development of the motion picture is the woeful lack of theaters to accommodate the tens of millions who have acquired the liking for motion pictures. It is estimated that the portions of the globe in which the industry is now solidly entrenched could find immediate use for more than 20,000 large theaters today, and the need is constantly growing as the interest of the population in pictures increases. The war put a stop to theater building in all countries which engaged in the war and placed a damper upon such operations in neutral countries because of the lack of materials and labor The return of peace has not improved conditions in this respect, the shortage of buildings for homes and industrial purposes is so serious that it will be several years before restrictions on amusement enterprises are removed.

Great Britain today has approximately 2800 theaters catering to the motion picture public The industry there has urgent need of 3000 new theaters but cannot get them until the present drastic building rules are changed The result is that every house is crowded to capacity, and enormous sums must be paid before a theater owner will surrender his business to another Theaters built before the war now command prices 400 and 500 per cent above the pre-war levels, and are hard to obtain at any figure

Another country in dire need of theaters, in so far as the motion picture interests are concerned, is France There has been no theater building for six years, and it will be several years before new buildings can be undertaken on a large scale. Prior to the war France was not liberally supplied with theaters of this class, many cities possessing a population of 60,000 or more being without first class motion picture theaters. To provide for the ample accommodation of the millions of new "fans" France, it is estimated by competent authorities, should have several thousand modern theaters. The shortage is especially acute inasmuch as France is a large and important producer of motion pictures on its own account

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Soap Science

Recent Developments in the German Industry

By Arthur H. J. Keane

FOR the past 20 years or so formaldehyde soaps have been placed in the market which were intended to be used partly as antiseptic and partly as disinfectant soaps. The antiseptic kinds are soda soaps which, like ordinary grain soaps, are used for washing the hands, the disinfectant soaps are liquids which, when diluted mostly with warm water, are used not only for disinfecting the hands but also for disinfectant purposes in connection with sick beds, hospitals and the like. Solid formaldehyde soaps have, owing to their slight effect, not been largely introduced into practical use, liquid potash formalin soaps enjoy a wide-spread use. The latter are made mostly by treating fats with an oxy-acid radical, or from the oxy-acids themselves by saponification with potash lye and subsequent treatment with formaldehyde which latter possesses the capacity of dissolving the potash salt of the oxy-acids, probably forming double combinations at the same time. If the preparations thus derived are to be used for disinfecting the hands, then it is compulsory to dilute them in a suitable manner This is effected preferably with the aid of warm water, numerous experiments having shown that formaldehyde, at a low temperature such as that of a room for instance, only exerts a very poor disinfective capacity With the slightest rise in temperature, on the contrary it is observed that a marked increase takes place in its disinfectant forces, closely approaching at 35 to 40 deg. Cent. that of a cresol solution of equal concentration, in fact it is even far superior to that spore-containing material.

As mentioned above, oxy-acid potash soaps possess the property of being dissolved by formalin, this, however is not the case with the common sebacic acids or with unsaturated acids. Now if a mixture be used consisting of oxy-acid and ordinary sebacic acid, if this mixture be treated with potash lye and formaldehyde be added, then the oxy sebacic-acid potash will be dissolved, but the sebacic potash will be left practically undissolved The result is that a solution of the formaldehyde-oxy-acid potash forms in the remaining texture of the sebacic-acid potash, this produces a transparent soft soap, such as can, otherwise, only be obtained by means of saponification with alcohol or sugar The mixture of sebacic acid and oxy sebacic acid is effected in such wise that only so much oxy acid is used as can subsequently be brought into solution again by means of the formaldehyde On the other hand no more formaldehyde is used than is equal to about ¾ to 1 per cent of the total quantity so that all irritant phenomena may be avoided when the soap is being used practically

These soaps are now undergoing commercialization in Germany They are intended to be used for direct contact with the skin and, in this case, the natural heat of the body takes the place of the warm water otherwise needed to dilute the liquid formaldehyde soap. Owing to its absolutely neutral composition the soap does not attack the skin, so that it can be allowed to remain upon the skin for hours at a time if necessary without the hands being prejudicially affected in the slightest degree For practical use a modification of this basic soap is provided for, viz., by the addition of glycerin From the observations made this glycerin must be added to the acids prior to saponification It must be especially remarked that it is not possible to work glycerin into the soap by using triglycerides in place of sebacic acids, on the contrary the acids must always be taken as a working basis, the glycerin being added thereto. If it be desired to add other cosmetics, this must also be effected prior to saponification Whether this new preparation will give full satisfaction as a disinfectant for the hands, especially for surgical requirements, remains to be seen, so far no practical tests in that direction have been carried out, however fair practical tests made in the laboratory have shown that its disinfectant action on bacteria is fully equal to that of formalin soap solutions of similar strength containing the same percentage of formaldehyde at temperatures of 30 to 35 deg Cent Hence the inference is that this soap should give satisfactory results in all cases where it is necessary to secure a rapid disinfection of the skin by rapid and simple means. The soap is rubbed upon the skin of the hands, or any other part of the body that has to be treated and, after being allowed to act for a few minutes, is washed off with cold or warm water When the soap is applied to the skin it produces a pleasant cooling effect, and after removal leaves a certain dryness which is by no means unpleasant, especially in summer

It is proposed to place this preparation upon the market in tubes so as to render its use as general and popular as possible, and with a view also to affording the public at large an opportunity of obtaining a pleasant and easily applicable toilet disinfectant It should also be used after handling railway and other tickets, after journeys, in factories and offices containing bacterial dust and in all similar cases. Of course it can also be used in all such cases where formaldehyde has, hitherto, been medically prescribed, and more especially when it is desired to produce a hardening effect upon the skin

Another interesting development is in the field of solid and molded soaps. It is already known how to mix various chemicals including soaps, in the form of powder and then to press the mixture into pieces of certain shapes It is also known to mix soaps with medical additions, the mixture being then allowed to dry, whereupon it is disintegrated and finally, by means of moderate pressure formed into balls or tablets. It has, furthermore, already been proposed to prepare a mixture of liquid tallow grain soap with water or silicious lime, this mixture being worked up in the usual way

All these processes, however, did not prove advantageous in practical use, especially if it was desired to manufacture on a large scale highly filled, solid and molded soaps of a nature to comply with modern requirements In this case the stamping process was not practicable because, on the one hand it required too much power while, on the other hand, there was considerable wear and tear on the machinery and in addition to all this it is not every soap mixture that is applicable for this process. There were also other drawbacks, well known to those versed in this industry

(Continued on page 140)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Recent Bombing Operations

To the Editor of the SCIENTIFIC AMERICAN

After reading in the daily press that only two bombs out of eighty hit the "Iowa" during the recent aircraft maneuvers, it would appear to the layman that the problems attending such operations are no nearer solution that they were several years ago Aviators are still unable to score but a small percentage of direct hits, and in the final analysis it is the direct hit that counts, the depth bomb and all other indirect-hit makeshifts to the contrary notwithstanding

Air-bomb development has proceeded on the assumption that since the making of a direct hit was a matter of uncertainty, the greatest efficiency would be attained by using planes that carry a few large bombs, and as a consequence, if the bombs were big enough a near-hit would be just about as destructive as a direct hit. We hear much about the size of aerial bombs and the tonnage the big bombers carry, but nothing concerning any advancement in the all important requirement of hitting the target The reason for this is that the present method of air-bombing is so unscientific that to hit the bulls-eye is largely a matter of chance Further improvement in the ability to hit with one big bomb is hardly possible.

But a larger percentage of direct hits can *be made, nevertheless, by employing methods better calculated to achieve such a result.* Let us consider these facts The trapshooter uses a shotgun to hit flying targets, instead of a rifle, for the evident reason that the closely spaced pattern of the shotgun affords several hundred more chances of striking the target than the one bullet of the rifle. The aviator who endeavors to make a hit on even a stationary target when he and his bomb are moving at high speed is handicapped precisely as the rifleman is when he endeavors to break any considerable number of moving targets. The conditions are reversed, but the difficulties attending successful performance are the same If the aviator's target is in motion, his task is still more difficult.

That is the way it looked to the writer back in the World War, so he began the development of a method and devices whereby the efficient pattern of the shotgun and the rapidity of fire of the machine gun are combined for the discharge of bombs from aircraft. The equipment was designed to handle any size bomb, and was adapted to operations over land or water Competent engineers assured the writer that the device would function as designed, that a plane so equipped would lay an inescapable pattern of bombs over its objective and increase the chances of making a direct hit several hundred to one, as compared with the hit-or-miss, one-at a time method The plans were taken to Washington and a special board of the Bureau of Ordnance in its report stated as follows "Inasmuch as the tendency will unquestionably be in the direction of arming these planes with one or two large high powered bombs, rather than with groups of smaller bombs, the necessity for your invention is believed to be non-existant" It is proper to point out here that the specifications said nothing about small bombs The author of the board's letter drew that conclusion himself. The device was rejected not because it lacked merit, but solely because the board was working along a certain line to the exclusion of every other

Was there any "necessity" for such an invention? German submarines at that very time were taking heavy tolls of lives and shipping They had even visited our Atlantic coast, and in sinking a vessel fired shells that lodged in our soil. While thus engaged, a German U boat was attacked by a couple of our planes which dropped a number of bombs at her without making a hit. Yet this board said there was no "necessity" for an invention designed to destroy the submarine

Hon. Josephus Daniels, in an article in the *Saturday Evening Post* of April 23, 1921, entitled "The Navy That Flies," quotes Frank J Sprague, "an eminent member of the Naval Consulting Board," who is referring to air bombing operations, says In one series of tests against a stationary ship there were 11 per cent. of direct hits Mr Daniels himself says in the same article "The duty now uppermost with fighting fliers is how to hit the mark

The operations against the 'Iowa netted 2½ per cent of direct hits

Is there any necessity now for a more efficient method of air bombing? J H MURRELLE.

Sayre, Pa

When Humpty-Dumpty Travels

To the Editor of the SCIENTIFIC AMERICAN

I have read with much interest your article of April 2nd under the above title This subject is always interesting as we are continually striving to confine such damages to a minimum. The article itself is true to actual conditions, which we are encountering every day, to wit, eggs in second hand cases or with flats and fillers not coming up to the standard and not properly stowed are continuing to produce breakage and result in claims, whereas the new standard case well packed and containing 3¼ ounces excelsior cushions, top and bottom and between the first and second layers of each case shows little or no damage

The reference on page 278 as to only $19 damage on a car that was in a wreck, on which an experienced freight estimater estimated the damage at $1000, he being of the opinion that the eggs were packed in standard cases with honeycomb fillers, refers, I believe, to the cup filler which is shown on the right hand corner of page 265 It is our experience that this particular filler is by far the safest kind now in use and we hope it will be the authorized filler until such time as a better one is invented The continual agitation with respect to breakage of eggs when cases and fillers do not protect the contents will have the result of greatly reducing the amount of breakage as compared with what it was a year or more back, so we will continue to make known to any delinquent shipper defects that should be remedied, as well as suggestions for improvement. W J EDWARDS.

Trunk Line Freight Inspection Bureau.

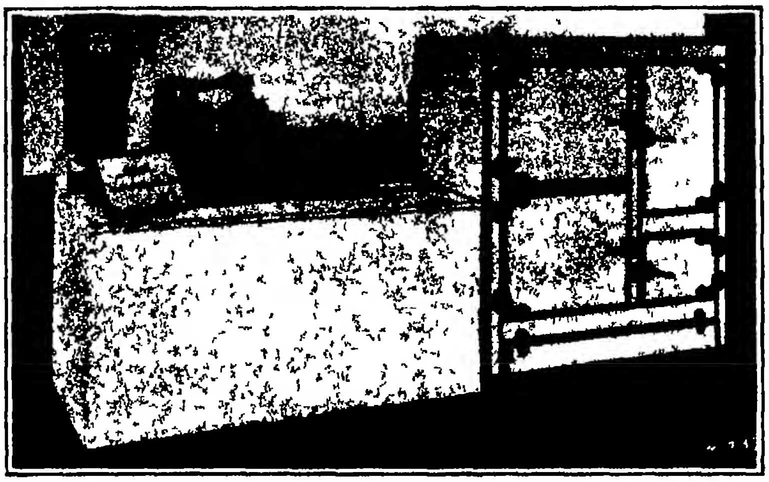
Doing Away with the Ice Man

How Electricity Has Brought a Cleaner, Drier and Colder Atmosphere to the Refrigerator

By Albert A. Hopkins

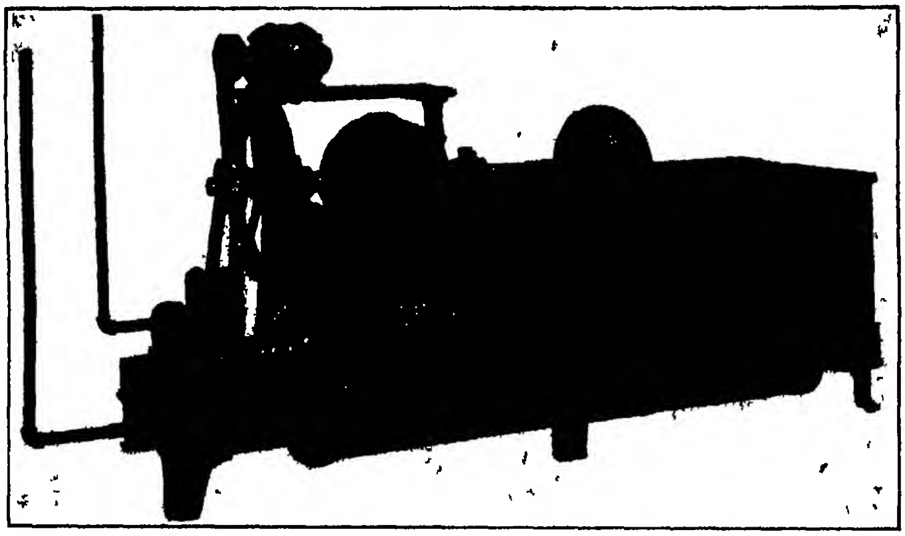
ONE of the constant problems of the average American household is ice. Ice is necessary to keep the icebox cold and to preserve the food placed therein. And ice means that the average American household must depend upon the tender mercies of the ice man and that is precisely the root of the whole trouble.

The numerous attempts to emancipate the average American household from the ice man have taken the form of a number of practical refrigerating systems that operate by means of small electric motors and at a very low cost. Five of these systems may be considered as typical of these machines, and we are indebted to the New York Edison Company of New York City for the accompanying data and illustrations. Incidentally, it may be added that the New York Edison Company recently devoted their display space to an exhibition of domestic refrigerating devices with highly gratifying results, indicating that there is a steadily increasing desire on the part of the average American household to turn to some mechanical means of keeping the icebox cold.



A sulfur-dioxide machine of compact dimensions which makes a feature of its easy attachability to various standard refrigerators and its thermostatic control

One of the sulfur-dioxide refrigerating machines is externally a shaft carrying at one end a drum, at its middle another drum, and at its opposite end a pulley. Its appearance is practically that of a large dumbbell and when it is mounted its end drum is in contact with water, brine or other liquid to be cooled, and the other drum is in a similar tank of flowing water to carry away the heat. Bearings hold it in place. There are no joints, valves, gages or stuffing boxes. This machine operates on the compression system, using sulfur dioxide as its refrigerating agent. The compressor—which it was possible to reduce to its simplest elements because of its peculiar situation—hangs loose on the shaft inside the condenser drum and is held in position by means of a counterweight. By no possibility can the machine operate to increase the pressure beyond the limit determined by the design of the counterweight. It is this feature of the machine that makes it practical for domestic refrigeration.

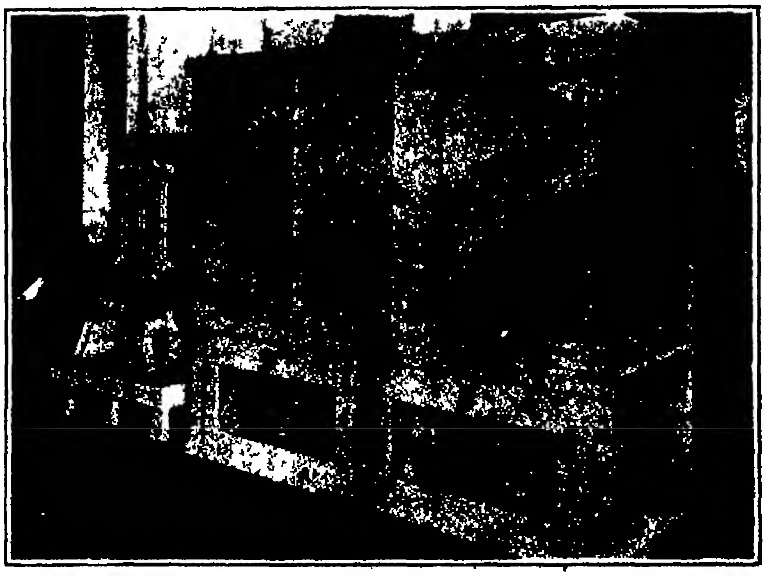


An ice machine that employs sulfur-dioxide, and that boasts a counterweight which prevents the pressure from going too high

Another machine is sent out from the factory completely charged and ready to operate. The air is entirely exhausted and the charge of sulfur dioxide and a pure neutral oil is admitted, after which the machine is hermetically sealed. The working parts are thus constantly lubricated, not by the power-consuming churning action so often mistaken for good lubrication, but by a distribution of oil so that metal-to-metal contact practically cannot occur at any point. Pressure in condenser is constantly forcing oil between the working surfaces of the compressor.

Where electric current for power is obtainable at 6 cents per kilowatt hour and condensing water at $1 per 1000 cubic feet these machines will furnish refrigeration at from 16 to 22 cents per hundred pounds of refrigerating effect.

In another system of refrigeration ethyl chloride is used, which is nonpoisonous. The machine comprises the following essential parts: motor, compressor, condenser, separator, expansion valve and cooler. The cooler is placed directly in the refrigerator and filled with liquid ethyl chloride. A line from the top of the cooler leads to the suction side of the compressor. The discharge side of the compressor is connected through a line to the top of the condenser. A line leads from bottom of the condenser directly to the separator located at the bottom of the condenser. An automatic expansion valve is built into the head of the separator with a line leading from the same back to the bottom of the cooler. The refrigerating cycle is as follows: The compressor creates a vacuum in the cooler causing the liquid to boil, reducing the temperature of the same and taking up the heat from the refrigerator. This gas is drawn into the compressor and discharged at a slightly increased pressure into a condenser. The condenser shell contains a water coil which cools this gas while under compression, causing it to condense. The condensed liquid drops into the separator and passes to the expansion valve which automatically controls its flow back to the cooler, from which it is again boiled out, making the cycle complete and continuous while the machine is running. The lubricant is carried in the bottom of the separator from which a line leads to the compressor. The condenser pressure forces this lubricant to the compressor bearings from which it is led into the compressor and discharged into the condenser with the ethyl chloride gas. When this gas is condensed into a liquid, the lubricant, having a higher specific gravity than liquid ethyl chloride, drops to the bottom of the separator from where it is again forced to the compressor. The flow of the lubricant is also continuous when the machine is in operation.



External view of the refrigerating system which makes use of ethyl chloride

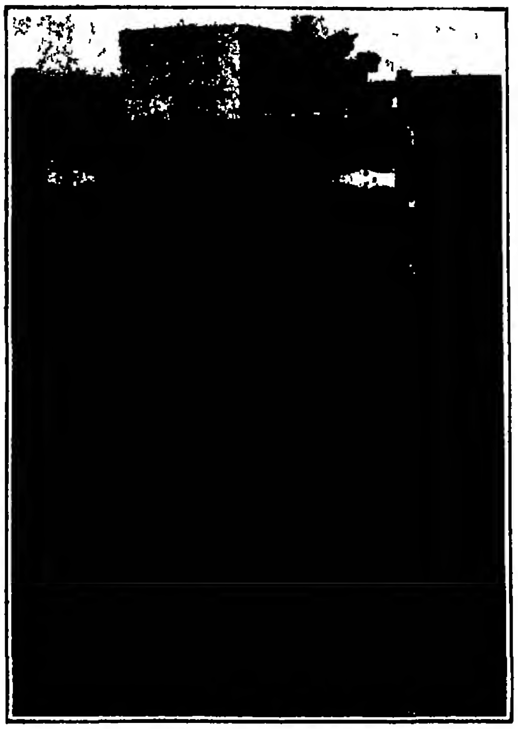
Then we have a sulfur-dioxide machine in which the compressor and condenser chambers and motor are mounted on a single base which may be located in any convenient position near the refrigerator, or in an adjoining room or even in the basement. The brine tank, made to fit various standard refrigerators, is placed in the ice compartment and is connected to the machine by two seamless copper tubes and acts as a storage battery for the cold. The only moving parts of this machine are the two rotating gears of the compressor, which run submerged in a sealed chamber of oil and are directly connected with the one-quarter horsepower motor. The use of this simple compressor eliminates valves and reciprocating parts. The refrigerant—sulfur-dioxide, a harmless gas—is also sealed in the system. When cooled under moderate pressure it becomes a liquid and as such is supplied to the expansion coil of the brine tank where it expands into a gaseous form, extracting the heat from the refrigerator. When it has absorbed its quota of heat, the compressor removes it from the expansion coil and delivers it to the condenser chamber where the water, circulating through the cooling coils, absorbs the heat and the gas again becomes a liquid and is ready to start on another journey. This simple process is carried on in continuous cycles. The machine is automatically operated and can be set to maintain any suitable degree of cold in the refrigerator, the machine starting and stopping at the predetermined temperatures. The household machine is capable of cooling well insulated refrigerator space of from 25 to 40 cubic feet.

Another sulfur-dioxide machine, which we do not illustrate, operates on the compression system under low pressure and has an expansion side and a

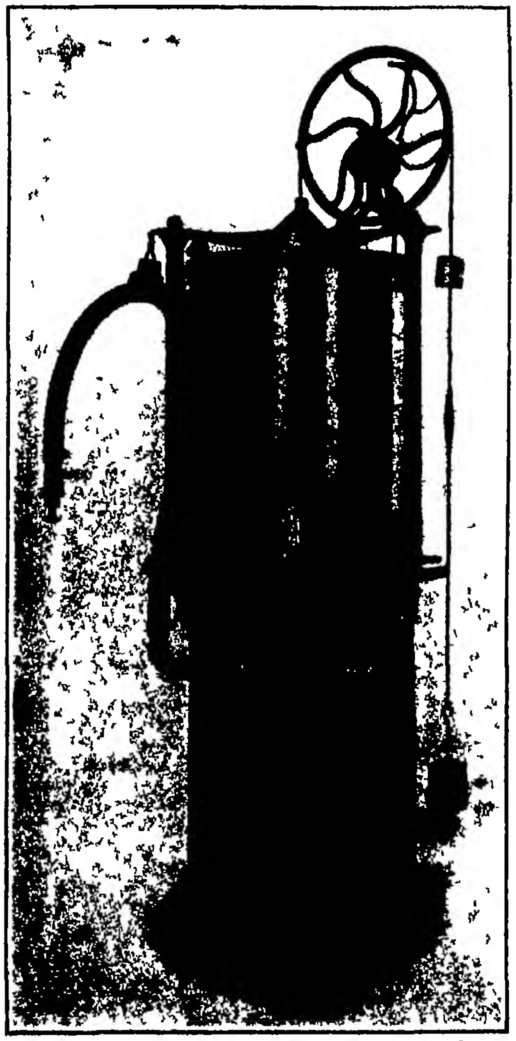
compression side. The expansion side consists of a copper tank filled with salt brine, in which the expansion coils are located. This tank is put in the ice chamber of the refrigerator. On the top of the tank is an expansion valve of the diaphragm type, and the refrigerant which is sulfur dioxide (SO_2) is expanded through the coils in this tank under a normal working pressure of 6 to 8 pounds when the machine is idle but about 3 pounds or less when running. After passing through the coils in the brine tank, the gas goes direct to the compressor, which is of the double cylinder, S. A. type and air cooled. It is then compressed and discharged into the condenser, which is a rectangular coil of ½-inch copper tubing, immediately surrounding the compressor and motor, all being mounted on a substantial base. The condensation of the hot gas in this coil is accomplished by air cooling, no water being required. The normal condensing pressure is 60 pounds but may run to 80 pounds under unduly warm atmospheric conditions. At the bottom of the condenser coil, liquid is carried off through a ¼-inch copper tube to the expansion valve, so as to give no more liquid than necessary to accomplish proper refrigeration. On this system only 3 valves are used, a suction on front of compressor, a discharge on top of compressor, and one at end of condenser coil. The entire system is tested at 350 pounds' pressure, therefore the chances of leakage are very slight. The compressor is operated by a ¼ horsepower motor, belt connected, and supplied with an idler. The motor is controlled by a thermostat situated on top of the brine tank. This thermostat is of the syphon type, and when the temperature in the refrigerator reaches too warm a point, a switch is thrown and the motor and machine run until the box is cooled down, when it automatically cuts off. The running of the machine is therefore intermittent instead of constant, and under normal conditions will cover a period of eight to ten hours out of the twenty four.

The outfit illustrated on this page consists of a refrigerating machine of 150 pounds ice-melting effect per day mounted on a heavily insulated box 5 feet high, 4 feet wide and 2 feet deep. A brine tank containing about 100 pounds of brine is located in the upper left-hand compartment of the refrigerator. In the brine is immersed a coil of pipe containing several pounds of the liquid refrigerant—ethyl chloride. When the temperature of the box rises to 44 degrees a thermostat closes the circuit-breaker on the electric motor, which is directly connected to the compressor. The compressor removes the vaporized refrigerant from the immersed coil thus causing a slight reduction in pressure and consequent further evaporation of the liquid and absorption of heat from the surrounding brine delivering the vapor, heated by compression to about 150 degrees, to the condenser coil. Here it is cooled by the circulation of air at room temperature. This cooling causes the vapor to liquefy, after which it collects in the chamber of the float-controlled expansion valve, from which it is intermittently returned to the vaporizing coil in the brine tank, when sufficient liquid has condensed to lift the float. The cycle of heat absorption, vaporization, compression, cooling and liquefaction is repeated until the box temperature is lowered to 42 degrees, when the thermostat again operates, opening the circuit breaker and stopping the compressor. The front of the brine tank is recessed so as to form a small chamber or 'oven' which is provided with six pans and removable cubing grids for making ice for table use, or frozen deserts. This gives an ice-making capacity of 16 pounds or 72 2-inch cubes. The compressor is of the rotary valveless type operating at 1150 revolutions per minute and supplied with a pressure feed lubricating system, and is mounted directly on the frame of a ¼-horsepower electric motor. On the motor shaft between the compressor and motor is mounted a multivane blower which induces two air currents, one over the compressor, and the condenser coils accomplishing the liquefaction of the refrigerant, the other, over and through the motor, enabling it to operate at full load if necessary without any possibility of overheating. The air is then discharged through the top of the ornamental cover which conceals the refrigerating machinery. The machine will operate about eight hours a day with a power consumption of 2¼ kilowatt-hours.

Having now described these types which are safe for domestic use, it may be said in passing that we are not discriminating against the ammonia machines but we feel that the types shown will prove satisfactory for small installations while the ammonia system is of course more economical for large plants. We need hardly refer to the enormous efficiency of refrigeration by electricity in the household for though the initial expense seems high and the cost of operation is also high—if current is dear, yet the saving in not having to clean out the ice compartment, not having to bother with the water caused by meltage and the assurance that the ice is pure is of enormous value. The time will come when those who build houses will reckon with their refrigeration problem as they do now with their plumbing, lighting, or heating or heating plants.



Another refrigerating machine which uses ethyl-chloride



Small gas tank which serves the purpose of checking up the accuracy of domestic gas meters

Is the Gas Meter Accurate?

THE consumer finds that the periodical bills presented by the gas company for gas used for lighting and cooking purposes vary widely from month to month. It may be that the demands of the consumer are responsible for the fluctuations. Not infrequently, however, a faulty or seemingly gluttonous meter fails to record the consuming flow unerringly. Even the company's reader of meters may unjustly be criticized for the misgivings of an erring meter, the employes of the corporation being charged with hasty conclusions. Anyway widespread complaints question the accuracy of the consumer's meter, and this Government of ours being one of checks and balances, a mechanism has come into use for keeping tab on meters.

These meters resolve themselves into two types—the automatic and the standard. The latter, as shown in the accompanying photograph, is most suitable and more generally used for inspection work. Some states make it compulsory for gas companies to own a prover, and the National Bureau of Standards subscribes to the opinion that any company owning as many as 200 or 300 meters is justified in acquiring a 2-foot or larger prover. Otherwise it is suggested that a small company have its meters tested by a substantial company in a neighboring town. The instrument is designed for testing consumers meters on a commercial scale, the Bureau of Standards explaining, "The testing of meters in place on customers' premises has never been successful for regular work.

The tank of the 5-foot prover, as illustrated, is made ring-shaped so that its water consuming capacity will be kept at a minimum. Such a specification enables the prover to assume room temperature more rapidly, permits of quick filling and emptying, and deprives the outfit of some of its cumbersomeness. The annular tank, however, has its shortcomings, namely, difficult to clean and repaint. The bell is made of copper, considered to be economical and to offer more resistance to corrosion. A copper or brass bell retains its new appearance when well polished and by oiling it water will not adhere to its surface. The prover is elevated from the floor by legs with screw feet, which arrangement facilitates the leveling of the apparatus for testing. Not unlike the object to be tested, the prover is not infallible. Hence these cautious injunctions. The prover must be mathematically correct, perfectly level, duly counterpoised, and adjusted so as to give uniform pressure from top to bottom during the movement of the bell.

The scale can be screwed to the bell and pointer on the tank or it may be placed on one of the pillars which carry the bell support, the pointer being located at the top of the bell. The air thermometer is mounted half way up one of the prover pillars, sufficiently removed from the operator that his presence will not influence its readings. Preferably, the water thermometer is so mounted that with its bulk in the water of the prover tank it may be read without being touched by the operator. The smallest divisions on the thermometer should represent a temperature difference of not more than one degree Fahrenheit. Both thermometers are tested to establish their accuracy.

Provers are manufactured in 2, 5, 10 and 20 cubic-foot sizes. The Bureau of Standards suggests a convenient set up for routine meter testing. Two provers are satisfactorily located with a bench between them for a single operator, suitable connections to prover and to vent being provided. From 60 to 80 meters can be examined in a day by one man. Either gas or air can be used in meter proving, many companies, however, favor the employment of gas, claiming that air dries out the diaphragms of the meters. Testing is negotiated under a pressure of 1.5 water, where the latter is used in proving. Meters should stand near the prover five or six hours before testing. The temperature of the room and the water in the prover should not vary more than one degree Fahrenheit. Hose coupling of suitable size is selected for connecting the meter with the prover.

Once having closed the connection of prover to the meter, the former is filled with air. The outlet is connected to the vent, allowing one-half to one or more cubic feet of air to pass through the meter to see that it is functioning properly. The tightness of the connections and of the meter are tested, then air or gas is passed through the meter to bring the test dial hand exactly to one of the division lines of the dial. Adjust the prover by raising above zero mark, allowing air to escape until it is exactly at zero. Open connection to meter and permit air to pass till one revolution of test hand has occurred, which requires 2, 5 or 10 cubic feet of ar, dependent upon size of the meter. Forthwith record the reading of the prover to the nearest one-hundredth cubic foot, and from this calculate the error of the meter.

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Aluminum Wings

AMONG the things which could not be done is to be listed the preparation of aluminum alloy sheets of sufficient strength and thinness to make them useful for airplane wings. While airplanes with metallic wings have not as yet displaced the fabric wing type, still a number of very successful flights have been made with metallic wing models in which the aluminum alloy is used in place of the silk or linen or cotton fabric heretofore employed exclusively. These metal sheets are rolled down to a thinness of 0.0025 inch, which is a little more than one-third the thickness of the safety razor blade, which is 0.008 inch. This thin aluminum alloy has a tensile strength of 60,000 pounds per square inch and is indeed a remarkable product.

Glue Stains

THE vegetable and casein glues, which are extensively used at present in preparing laminated and veneer woods, particularly from oak, maple, cherry, elm, ash, birch, and beech, are prepared with the aid of caustic soda. Some of these glues stain the wood more than others, those containing the most alkali being the most injurious. The staining is believed to be due to the action of the alkali in the glue on the constituents of the wood, particularly the tannin, from which an ink-like substance is formed. No way has been found as yet to prevent this chemical reaction, but in technical note No. 146, the Forest Products Laboratory indicates methods whereby these stains may be reduced to the minimum. The greatest trouble comes from the penetration of the glue through thin face veneers, especially if the veneer is less than one-twentieth of an inch thick. Since the thinner glues show a greater penetration than the thicker ones it is obvious that where thin veneers are used it would be well to use the more viscous glues or to use fillers in the glue when staining is feared. It has been found that if drying after glueing is accomplished promptly the solution has difficulty in reaching the surface. If some flat object is placed between panels in the press staining is decreased.

The casein and vegetable glue stains can be almost completely removed by sponging the stained surface with a solution prepared by dissolving one ounce of oxalic acid crystals in about twelve ounces of water. The more stubborn stains should be moistened first with a sodium sulfite solution of the same strength as the oxalic acid solution and then follow this treatment with the acid.

Synthetic Alcohol

DURING the year Calvert, in England, has developed a process for the direct synthetic production of alcohol from water gas and producer gas by catalysis. It is claimed that ethyl alcohol of 99.2 per cent purity has been obtained from ordinary water gas with a yield of 90 per cent.

Already research is in progress looking to the synthesis of methanol, which is almost as important as ethyl alcohol, being the principal raw material in the manufacture of formalin although the quantity used annually is not so great as for the other alcohol with which it is often confused by the layman. With ethyl alcohol now being made successfully from a variety of raw materials as well as synthetically, there ought to be no difficulty in meeting the world's demands at a reasonable price. In Brazil they are finding it possible to operate trains on the sugar plantations with alcohol produced from the molasses tailings, this alcohol being produced for less than twenty cents per gallon. The distillation of hard wood continues to be our sole source for methanol, and with the rate at which our hard wood is being used we should already have increased interest in the possibility of developing laboratory methods for the production of this important solvent.

Colorado Shale Oils

PROFESSOR A. J. FRANKS of the Colorado School of Mines reports the results of studies of Colorado shale oils in the July 13th issue of *Chemical and Metallurgical Engineering*.

Colorado shale oils and their fractions contain much nitrogen which seems to be present as basic compounds, and complex, unstable, unsaturated substances of high specific gravity and molecular weight. The distribution of nitrogen is similar for each of the three oils studied, the heavier fractions containing by far the larger amounts. Cracking of the latter during distillation effects a great loss of nitrogen and masks its true distribution. The total loss observed was about 40 per cent of the nitrogen occurring in the crude oil showing that one of the classes of nitrogenous substances is very unstable."

The author found sulfur to be less in the light and heavy oils and greater in the middle oils. The amount of sulfur in the heavy oils was reduced by the cracking process, showing that at least part of the compounds which decomposed contained sulfur. About one-third of the sulfur in the crude oil was lost during the distillation process, but in spite of this the distillate contains about the same percentage as the original oil.

From this it would appear that the saturated oils formed by cracking are produced from unsaturated compounds containing sulfur and nitrogen which are easily decomposed during destructive distillation. The author proposes to carry on the work on the changes wrought by successive distillations of shale oils.

Hard Soap

A PATENT has been granted for the use of sodium acetate and sodium lactate as a hardening agent in soap making. The patent is No. 1377848, and it is claimed that these reagents impart to the soap greater detergent qualities and firmness without the deleterious qualities to be found in strongly alkaline soaps. The addition of sodium acetate is accomplished in the manufacture of transparent soaps by incorporating sufficient acetic acid to neutralize the excess alkali. The sodium acetate thus formed permits a neutral soap for which the best grades of stock are required, and in the case of transparent soap, alcohol must be added. Increased hardness is obtained by finally adding one or two per cent of sodium acetate or lactate, the lactate being superior in promoting transparency.

It is stated that a transparent soap may be made along these lines from a mixture of 50 per cent tallow, 30 per cent cocoanut oil, and 20 per cent castor oil. Excess water which ordinarily would prevent the hardening of the soap, does not interfere as the addition of a small amount of acetate will cause it to set. The resulting soap will be of a transparent character and retain its content of glycerin and the added alcohol.

Atmospheric Corrosion

THE Committee on Corrosion of Iron and Steel of the American Society for Testing Materials reported that tests which have been in progress for five years in the Pittsburgh district on uncoated metal sheets are nearing completion and have now reached the point where the committee definitely concludes that "copper-bearing metal shows marked superiority in rust resisting properties as compared to non-copper-bearing metal of substantially the same general composition from which superiority we may truly anticipate a marked increase in the service life of copper-bearing metals under atmospheric exposure of uncoated sheets." Other corrosion tests are being conducted in different parts of the country, and before very long a final report may be expected in which results of importance will be stated.

Anthraquinone

ANTHRAQUINONE is the basis of the largest class of vat colors for which we have been clamoring and in the production of which our dye manufacturers have been somewhat deficient. Anthraquinone is usually derived from anthracene. The difficulty in obtaining adequate supplies of anthracene has been due to the fact that the usual methods for separating it from coal tar left the pitch residue so hard that it could not be sold for American uses. Such pitch does find a market abroad, particularly for the briqueting of coal dust and coke breeze, but there is no great demand for such pitch for this purpose in the United States. Unless the pitch can be readily sold, the anthracene produced by the old process becomes so expensive that the anthraquinone, and the vat dyes made from it, become too costly to be used. The process heretofore has been to dissolve anthracene in acetic acid and oxidize the mixture with bichromate.

According to a note in the June issue of the *Journal of Industrial and Engineering Chemistry* an electrolytic process known as the Thatcher Process has been developed, being an electrochemical one depending upon the use of a special type of cell. It is also claimed that the Thatcher method for removing the anthracene from the tar leaves a pitch which is marketable in America. At present a thousand pounds of anthraquinone are being produced per day, and the plant runs continuously. It is thought that the production of a thousand pounds per day will assure an ample supply for the next few months as, at present, consumption is lower than normal. About three million pounds of anthraquinone is required for the estimated annual consumption of vat dyes in America, although it is to be expected that with the manufacture of vat dyes here the demand for anthraquinone will increase. There has never been any question as to the presence of sufficient anthracene in American coal tars, and if the Thatcher Process accomplishes what is claimed for it a great advantage to the American dyestuff industry will have been gained.

Research in the Lime Industry

IN his report before the National Lime Association meeting in June, President Charles Warner, in his report, made the following statements relative to research:

Take, for instance, the problem of developing the best type of quick-hardening lime plaster and mortar. This question is of great importance to the construction field. It has been attempted more or less superficially and spasmodically by many manufacturers as well as in some of the past efforts of your association staff.

Under past efforts the problem has not been suitably solved for the broad welfare of the industry. It has not been until within the fiscal year just closing that we have been able to lay a broad plan for its study, utilizing fellowships at the Bureau of Standards and elsewhere for taking hold of particular phases of the problem with the intention of gradually bringing all these lines together into a broad basic report that will throw the fullest light on the proposition.

To get at this problem there are four major lines of study and research that have to be undertaken, and each of these four major divisions fans out into numerous sub-studies and minor researches.

First—The effect of burning, grinding and hydration in various combinations and in conjunction with other ingredients to locate any refinement in manufacturing processes that may stimulate hardening in the finished product.

Second—The study of any hardening materials which of and by themselves and upon addition to lime will harden the mixed product.

Third—Carbon dioxide is the ingredient first naturally employed in the normal hardening of plasters and mortars, but, limited by the slow effect and small quantity of this gas found in normal atmosphere, it becomes necessary to determine all materials, such as charcoal, which might absorb carbonic gas in quantity yet hold it so loosely that upon admixture with lime and water a quick release of the carbonic gas would produce rapid carbonization and hardening throughout the mass.

Fourth—It is within the bounds of possibility that we can locate a chemical compound which upon addition in small quantities to lime will immediately establish in the lime an entirely new set of hardening characteristics and solve our problem in that fashion.

Proofing Fabrics

FABRICS may be proofed against soiling or staining by applying a solution of cellulose nitrate or acetate to the surface. The penetration of the solution into the fabric is prevented by impregnating it with some such volatile liquid as benzine before applying the cellulose solution.

A patent has been granted on a process of using insoluble alginates formed on fabrics by padding them with a soluble alginate and then passing them through a bath of zinc sulfate or similar heavy metal salt. The alginate separates in a colloidal form, giving a water proof finish which is said to resist a boiling neutral dye bath.

Balloon fabrics are rendered more impermeable to gases by the use of a mixture of rubber and cellulose acetate. This is applied in the form of a colloidal mixture in such solvents as tetrachlorethane.

Painting with Metal Spray

(Continued from page 128)

particularly serviceable when outdoor structures, large castings, etc., have to be treated where they are located for the nonce or permanently The Schoop interests have devised a "Metallisator" of moderate dimensions which permits the rapid galvanizing, tinning, leading, etc., of quantities of small metal articles. The latter are rotated in a tumbling barrel or drum, and attached to the supporting shaft is a spraying pistol which oscillates so that it will scatter the molten metal in every direction By the aid of this machine numerous products can be handled quickly and cheaply In zinc coating by this means the protective metal penetrates into the pores and interstices of the supporting mass and produces a uniform film which is so nearly permanent that it will give without breaking to hammer blows and repeated bending stresses.

The Schoop process has been employed beneficially in leading the iron buckets of Pelton wheels in hydroelectric plants abroad. Ordinarily, these buckets, when exposed to on-coming sand and gravel, are rather rapidly worn away The lead coating arrests this destructive action, for the impacting abrasives actually tend to anchor the lead more securely to the underlying iron, while the grit or gravel exerts but a very moderate erosive effect upon the protecting film Chemical vessels of iron have been made resistant to corrosion by surfacing them, according to the nature of the chemicals to be handled with lead or aluminum. This expedient has insured longer life and brought about substantial economies.

As might be expected the main use of the metal-spraying process is for zincing This system has gained extensive recognition in Switzerland, France, Italy, and Germany Two years ago the Swiss Government adopted the Schoop method of galvanizing for the state railways and now employs it widely in the iron and steel shops and in the locomotive and car works at Neuhausen and Schlieren The transmission towers and spreaders of the St Gotthard electrified line, two railway bridges, and the underbodies of 20,000 cars have been zinc coated in this way Rain falling upon laden coke and coal carriers absorbs some of the sulfur content of the fuels, and this water promotes deterioration of any iron or steel it may reach. A zinc film is much superior to paint and more lasting as a safeguard against this harmful action The Swiss have also found it desirable to supplement the zinc coating of their bridges with one of sprayed lead wherever the steel or iron fabric lies in the sweep of gases from locomotive smokestacks.

According to the latest reports, the electro-pistol is said to be superior to the gas pistol both in a technical and in an industrial sense. The zinc coating ranges in thickness from .003 to .005 millimeters and a capable operative can galvanize a square meter of surface in the course of from 6 to 7 minutes. The potentialities of the process in the electro-technical and electro-chemical fields are too numerous to mention. A single example, however, will serve as a hint It has been established that a substantial gain can be made in the direction of increased efficiency and greater operative safety by partly coating high tension porcelain insulators with a film of copper deposited by spraying. The municipal electric plant of Stockholm has placed in one transmission line as many as 25,000 of these metal-coated insulators; and a porcelain factory at Hermsdorf is using a battery of Schoop pistols right along in the manufacture of insulators. The copper coating gives excellent contact surfaces, and owing thereto transmission resistances are reduced proportionately

Theoretical objection to the Schoop system has been advanced by some critics on

(Continued on page 139)

Starrett Combination Squares Graduated with Metric Measure Now Available

Machinists and carpenters working in metric measure will be interested to know that Starrett Combination Squares are now available with the blades graduated in millimeters and one-half millimeters. These squares are similar in all other respects to the well-known line of Starrett Combination Squares No. 33, listed on page 63 of the new Starrett Catalog No. 22. The metric squares are listed as No. 33 M and are made in three sizes determined by the length of blade, the latter being, respectively, 15 cm., 20 cm., and 30 cm. All sizes are sent equipped with Starrett Center Head, in addition to the regular frame, unless otherwise ordered. When ordered without center head, a suitable reduction in price is made. Prices of all sizes with and without center head are given in Starrett Catalog No. 22 B'

Improved Universal Bevel Protractor Added to Starrett Line

To all users of protractors, the Starrett line of these instruments has long been favorably known for their wide utility, accuracy and convenience. In the Starrett Universal Bevel Protractor No. 359, recently added to the Starrett line and listed among the new Starrett tools in the latest Starrett Catalog No 22 this utility and convenience has been still further developed.

Instead of the disc being graduated in degrees from 0 to 90 each way, the new protractor has a dial graduated to degrees throughout the entire circle. Encased in the body of the instrument is a new positive method of making fine vernier adjustments. All adjustments are so arranged as to permit of control from the center of the front side of the tool, a feature largely contributing to the superior convenience of this protractor in service This arrangement consists of three nuts centering upon each other the lower nut locking the dial in its rotative path the middle nut at a slight downward pressure engaging the fine adjusting device while the upper nut locks the blade at any point in its length. An acute angle attachment is also furnished by means of which small angles can readily be obtained.

Starrett Universal Bevel Protractors may be had with 7 inch blade or 12 inch blade or both, with or without leather cases. The protractor may also be had without the acute angle attachment, at a suitable reduction in price.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles.

Armored Truck to Foil Bandit Payroll Gangs

SPORADIC cases of lives lost and payrolls stolen in the ambush by bandits of armed but nevertheless practically defenseless messengers in the number of cities during recent weeks have kindled a new interest in the lead taken in New York, Boston, Chicago, Philadelphia, Cincinnati and Cleveland by banks, public utilities and other companies having constant need to transfer money and other valuables. The lead they have taken lies in the direction of greater security and enhanced service as well as less loss of life and money in the transportation of large sums through the thoroughfares of congested cities. Seeing an opportunity to render real service to industrial concerns, merchants and others by making a specialty of offering them safety and service in the transfer of payrolls and money while protecting their own transactions by means of the same conveyance, more and more banks are purchasing armored motor trucks.

Two large trucks of the type shown in the accompanying illustration, with armored bodies, transfer thousands of dollars daily for two big banks in down town New York. One truck—a 2 ton unit—carries a body of quarter inch steel. In addition to the driver, two guards generally man the truck on its trips. The guards, heavily armed, ride on the inside. The keys to the only door (in the side of the body) are held in the branch banks or in the possession of the guards riding inside the truck. In no case can the driver open the door. In the event of the truck being fired upon, the steel walls of the body are of sufficient strength to flatten ordinary lead bullets, while from their protected position in the interior of the 'fortress,' the guards can return the fire of bandits through "portholes" arranged for such an emergency.

Armored motor truck now employed in various cities for the transportation of large sums of money and valuables

A Step Ahead in Motor Bus Development

MOTOR busses as a means of transportation are growing daily in popularity. The motor bus of the past has not been perfect but its virtues have far outweighed its shortcomings. Passenger transportation by motor bus is rapidly leaving the realm of the experimental and entering into a period of sound development in its legitimate sphere. This development has been of two kinds. First, better management of bus lines; second, improvement in the vehicle itself. Motor bus service properly organized and operated so as to supplement existing transportation systems, affords the only practicable means of handling increased traffic in cities of moderate size, and of satisfying the demands of the public for better service without extensive and prohibitive outlay for new plants, trackage and equipment. As feeders for existing transit systems, as rush hour carriers and as successors of unprofitable branch lines of the present trolley systems, they have a field of usefulness which all transportation experts recognize.

The type of 'jitney bus' in use today is, however, as far from perfection as the automobile of fifteen years ago was from the motor car of today. The design and construction of the bodies are crude, the seating arrangements are unsatisfactory because they permit distasteful and unsafe crowding of the passengers and the tendency to overload has caused the expense of upkeep to equal, if not to exceed the return. Realizing that the future of the motor bus depends on the development of the vehicle fully as much as it does on improvement in the method of applying it to transportation problems, a prominent New York truck manufacturer has designed a new type of bus which is said to eliminate the undesirable features of many of those now in use. The body is constructed of steel, including under frame, upright, side panels and roof. Seats are either of cane or leatherette, are placed crosswise, interior fittings have been made to withstand severe usage, traveling conveniences such as seat upholstery and interior lighting have been greatly improved, ventilators are installed, curtains for the windows are furnished, illuminated revolving signs indicate destination, non-rattling windows and exhaust heating for cold weather have been provided, and the body has been placed on a chassis of such power and dependability as to insure regular operation under the most severe conditions. Although smaller and lighter than the usual trolley car this bus with its large pneumatic tires gives greater comfort and ease of riding than is obtainable in the trolley. In addition it has the speed and flexibility of operation which has been responsible for the ever growing popularity of motor bus transportation.

Laminated Wood Disk Wheels

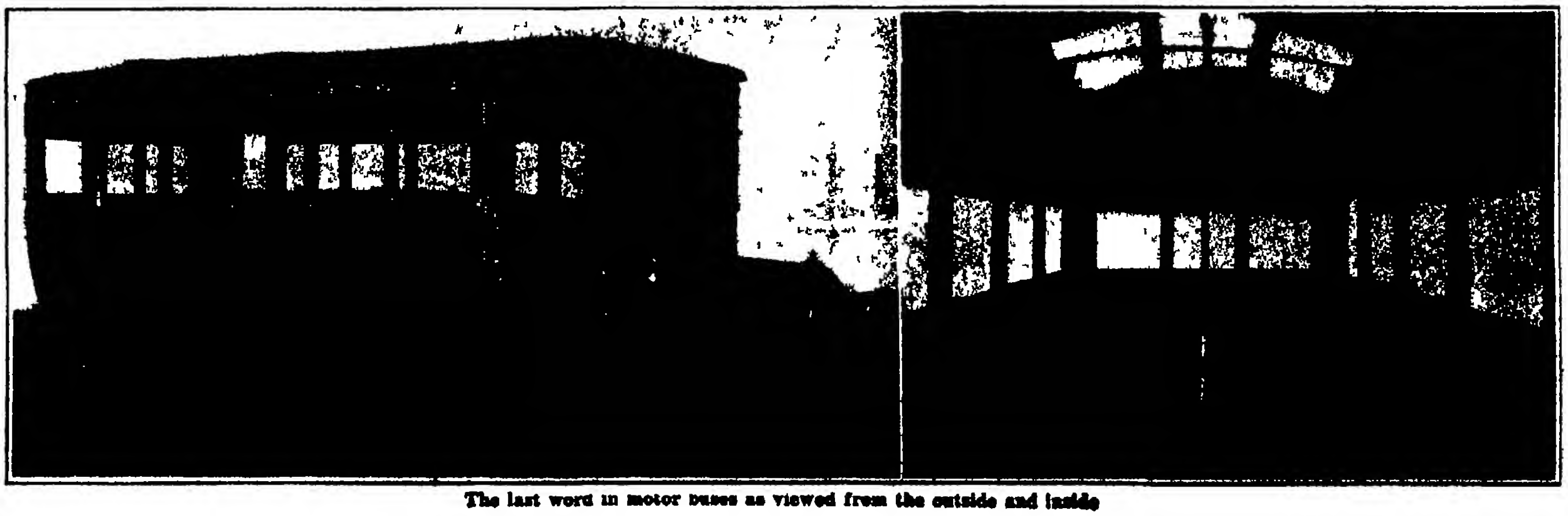
WHEELS with laminated wood disks are now manufactured for all types of motor vehicles. The disks are built up of thin, rotary-cut plies of wood glued together under pressure with waterproof glue. The grain of each layer runs in a different direction from that of the layer next to it. This process of lamination is said to make the complete disk very strong, non warpable and resilient. The weight of these wheels is substantially the same as that of a spoked wood wheel, but the resistance to transverse shocks is said to be much greater. In order to render inflation of the pneumatic tire convenient, a patented angle connection is furnished which goes on the tire valve stem and permits the tire to be inflated from the outside face of the wheel. The design of the wheel is such that the disk can readily be fitted to any standard hub and rim. These wheels are said to be stronger than the conventional wood spoke wheels of equal weight.

Use of Horses Becoming Less in Cities

THE Bureau of the Census, Department of Commerce, announces that 50,539 horses were reported in the City of New York at the census of 1920, as compared with 128,224 reported at the census of 1910. There has been a similar marked decrease in the number of horses in all the principal cities in the United States so far as heard from. Chicago had 30,888 horses in 1920, as compared with 68,122 in 1910, Philadelphia, 19,472 in 1920, and 50,461 in 1910. In Baltimore the number of horses reported at the censuses of 1920 and 1910 was respectively 7378 and 15,840, in Boston, 10,093 and 23,007, in Pittsburgh, 6032 and 12,845 in Cincinnati 5081 and 13,901 in Cleveland 4924 and 16,889. The above figures may be taken as an index of the growing use of motor transportation, both for business and pleasure in various municipalities.

Gasoline Cars Keep Railway Operation Costs Down

THE Carrollton & Worthville Railroad Co., operating a strip of road ten miles long, is the only company operating in Kentucky which has not raised passenger fares since the depression period began. This company solved the problem by shelving its steam locomotives and substituting gasoline motor vehicles. The cars have attracted the attention of short line railroad companies as far south as Louisiana and as far west as New Mexico. Automobile manufacturers have studied them with a view to their practicability for adaptation to street car service. Operation of one of these cars for one round trip costs $2, counting repairs, labor, gas, oil and depreciation. The trip with a steam locomotive costs from $15 to $18. There can be no doubt as to the practicability of gasoline car service on small railroads and branch lines, and we can look for a continued increase.



The last word in motor buses as viewed from the outside and inside

Painting with Metal Spray

(Continued from page 137)

the ground that oxidation would prevent the formation of a homogeneous layer of protecting metal Practical results contradict this assumption It is true that in most metallurgical processes gas and air do affect melted metal and frequently bring about rapid oxidation and on the face of it one might imagine that the same phenomena would occur with atomized, molten metals. But the speed with which fusing, projection, and "freezing" of the atomized metal takes place, in relation to the comparatively moderate temperature employed, is greater than the rate at which reaction would have to occur to induce oxidation In other words, it is feasible to melt and to solidify a metal so quickly that there is not time enough for the absorption of oxygen or other gases In proof of this, Schoop has fused lead and then sprayed it with a stream of compressed oxygen, obtaining thereby a normal homogeneous layer of the metal without any trace of oxidation'

In Germany wooden tobacco pipes and the inner surfaces of beer kegs have been "metallized to protect them against fire in one case and to make them tight and more durable in the other Telegraph and telephone poles have had their buried ends and a section immediately above the ground sheathed with a film of lead to prevent rotting, and the blades of air craft propellers have been coated with aluminum Metal spraying pistols are being used to surface with aluminum or copper aprons, smocks, gloves, etc, worn by workers in chemical factories and laboratories where the fabrics might otherwise absorb chemicals and become dangerously combustible if brought close to a flame The point to be noted is that materials which are normally considered more or less inflammable can be covered with a skin of metal without being injured in doing so Clay models and many other works of art can be gilded silvered, coppered bronzed, etc, by means of the Schoop apparatus The work is of such a character and the texture so true to the nature of the metal that the eye is readily deceived as to the identity of the underlying supporting substance

Housework in the Laboratory

(Continued from page 130)

tween sewing and sweeping and washing Washing at the tables of varying elevations exacted different ratios of heat output Twenty-one calories were required when the subject worked in a comfortable position, 25 calories when the pan was so stationed as to necessitate raising of the arms, and 30 calories when dishwashing was reduced to a back bending job The unpleasantness of the task was not broached by the experimental conclusions.

Laundry operations, both washing and ironing were not outside the province of these observations. The work was done on towels 16 inches square The washing equipment comprised a small galvanized iron tub and a scrubbing board, while the ironing was accomplished with a 5-pound iron on a table of suitable height. A towel was rubbed on the scrubbing board 40 times in 30 seconds, wrung by hand for 15 seconds, and then exchanged for another towel, 15 seconds being allowed for transferring The energy output in washing was 49 6 calories per hour, thus earning for the assignment the classification of laborious toil The presence of water in conducting the experiments would undoubtedly have increased the figures of heat requirement, as it would have enhanced the weight of the towel as well as wet articles would have offered more resistance on the scrubbing board and in wringing. Ironing proceeded at a rate of 70 strokes in 60 seconds, 10 seconds being allowed for exchanging towels. A cold iron was used lest heat should obstruct the measurements in the calorimeter The energy expenditure was 24 calories an hour, thus ironing being classified as moderate toil

The woman subject reposed in a common bentwood chair while knitting, crocheting, and hand sewing Motions, other than those involved in the immediate task, were kept at a minimum An uncompleted sweater was the object employed in the knitting operations, 23 stitches being administered to the minute A simple pattern and fine cotton thread were used in the crocheting experiments Hand sewing included varying types of work Making a plain unpadded scallop (blanket stitch) on the edge of a small piece of fine linen, at the rate of 18 stitches a minute, simple running on light cotton goods, 6 stitches being taken on the needle, one to one beat of the time measuring instrument, then the thread pulled through to four beats, with a total of 30 stitches per minute, hemming on light cotton goods, at a rate of 30 stitches to the minute, the thread being pulled all the way through after each stitch, darning light weight cotton hose with a thread about 24 inches long Such tasks entail a relatively small expenditure of energy, ranging from 7 calories an hour for sewing with the running stitch to 10 calories per hour in hemming The heat output while knitting 10 to 11 calories an hour, slightly exceeded that entailed in crocheting, 8 to 9 calories The variation is attributed to the wool sweater being knitted weighing more than the cotton lace which was crocheted Also a more liberal play of hand and arms was involved in knitting The materials in hand sewing being approximately of the same weight the differences in heat expended are attributed to the extent of movement required With a running stitch, 7 calories per hour the movement of drawing the thread to its full length was made only every six stitches or five times a minute, whereas with hemming, 10 to 11 calories an hour, it was made after each stitch or 30 times a minute Needleworkers, in practical operations, avoid the long thread because of undue exercising of the arms.

Advocates of modern conveniences in the home it would seem, can draw an effective object lesson from these experimental conclusions which accurately determine energy expenditure in the performance of household tasks Even under the most pleasing environments the housewife spends liberally of her reserve forces when the home is devoid of modern facilities, certainly the toll exacted is not a mere calculation of effort wasted but a sacrificial exaction where human values pay dearly and even the tenure of life is abridged

Simplifying the Coupling of Trains

(Continued from page 131)

Where this coupler is used the cars are coupled and uncoupled in the usual manner The headpieces or mating members of the Futrell coupler are suspended beneath the present draw-bar coupler and are automatically forced and guided together by means of spring pressure and guide members extending on each side of the opposing head The Futrell device maintains an airtight joint through its automatic self-locking coupler, and the gaskets meet just before the metal faces of the couplers touch which allows for some axial play This movement blocks the escape of steam or air and seals automatically any possible avenue of escape The coupler's metal pipes, which carry the steam, air and signal system, are hinged to the ends of the other car pipes by means of universal joints. This allows plenty of room or play when the cars take curves or cause movements which necessitate more or less of the freedom for which the rubber hose makes room.

The Futrell coupler connects the steam, air, signal, electric light and telephone lines on the trains without men going between the cars or coaches to make the

connections Any number of cars in a train can be connected in the same time as two cars are connected And the coupling is done instantaneously or in the same brief period of time which is required for the draw bars to come together There is no waste of time as is the case where a brakeman must fumble in his crowded position connecting up the rubber hose

The Futrell coupler is also uncoupled automatically when the cars are uncoupled The lever which disconnects the heads of the draw bar also releases the locking bars of the Futrell coupler and this operation is just as simple and rapid as where the simple connection is made

Mr Futrell had his first couplers introduced on the passenger coaches of the Los Angeles & Salt Lake Railroad running between Los Angeles and San Bernardino California The couplers were in constant service on this line for an entire year during which time they rendered the most satisfactory results Railroad men pronounced the test a complete success

On August 21 1919 the first train equipped with the new coupler arrived at the B & O railroad station at Frederick Md from Washington The officials pronounced the trip a greater success than they anticipated A decision was then made to place the coaches thus equipped in constant service for several months in order that a careful study could be made in cold weather After several months of continuous service or about March 1 1920 the couplers having been exposed to hard usage and subject to heavy strain were found to be in excellent condition and they were highly praised by members of the railroad fraternity The use of the couplers revealed some minor details which could be materially improved and Mr Futrell did not delay in making the improvements The alterations did not change the mechanical principle of the coupler but only eliminated some parts of the mechanism that might wear and tear some of the moving parts

The couplers in their improved form were installed on passenger coaches in service on May 1 1920 on trains running between Washington D C and Frederick Md These trial runs which were made to test fully the improved Futrell couplers are reported as entirely successful

Winning Foreign Film Markets

(*Continued from page 132*)

Every European country is from six to ten years behind the times in the matter of film theaters and finds itself in much the same position as Great Britain or France German motion picture interests are frantically engaged in overhauling all manner of buildings for amusement purposes so keen is the demand for motion picture entertainment The war did not deter German producers from keeping up their operations although their market was limited to Central Europe Approximately 600 new and improved theaters will be placed in operation this year and next it is said There is scarcely a block in Berlin Frankfort and other large cities without its motion picture house, and exhibitors are frantically scouring about for new sites

The estimated shortage of 20 000 theaters does not take into account such territories as India China Africa, Russia Western Asia the Balkans Central America and the hundreds of islands which dot the seas China were its motion picture interests developed to 50 per cent of the standard maintained in America would require more than 30 000 theaters alone More than 100 000 new theaters will be required to enable the development of the world wide film industry on anything like the scale attained in America

Prior to the World War French and Italian films completely controlled the South American market The war quickly snuffed out this business and the American companies stepped in with their product. The great majority of American pictures which had been shown in South America before this time could have been classified as 'junk and did not gain much respect for American films In those days the majority of American exporters were careless or indifferent as to the possibilities to be gained in Latin America and much of the film exported was from two to four years old

The war enabled several aggressive American concerns to gain a foothold in South America with their modern high grade photoplays and American films quickly gained the dominant position in this market Leading South American film men declare they will never go back to dependence upon European markets as they have found the American films greatly superior to European productions In 1919 a prominent exhibitor in Buenos Aires rebelled at the idea of having the door closed on French and Italian films and started a theater in which he proposed to show nothing but European pictures His venture was a complete and speedy failure for the fans of the capital could not be weaned away from their preference for American pictures

Another striking illustration of the tremendous growth of the export business of the leading American companies is to be found in the case of the Australian business of one concern Three years ago it started its Australian agencies with a total business of six per cent of all the films shown in Australasia Today it has more than 65 per cent of the business and is continuing to grow

Soap Science

(*Continued from page 135*)

Dr Adolf Welter of Crefeld (Germany) has now received a patent (Imp Ger Pat. 331715) whereby it is possible to make an almost odorless clay soap containing a low percentage of sebacic acid by a cheap and technically easy process For this purpose liquid or solid soap is mixed in a kneading machine with clay or any other filler This mixture which does not even require a thorough mixing together is then divided up into small porous pieces, for instance in a machine of suitable type These are then dried in drying chambers upon frames until they are ready for crushing up into powder by means of rollers This powder is then thoroughly and uniformly mixed together and it can then be molded into pieces of suitable shape by means of mechanical or hydraulic presses working at a pressure of from 50 to 300 atmospheres

The process here described (for coarsely crushing, drying and grinding the soaps with the filling materials, while in the first place avoiding the costly milling process and finally pressing the powder thus obtained into molds under high pressure) enables soda soaps to be made with less than 5 per cent sebacic acid and without the use of hard fats These soaps are also far superior to milled soaps due to their low percentage of water and a specially low degree of increasing the bulk or swelling

Cement for Leather Driving Belts

An extremely tenacious cement, consisting of 12 parts asphalt 10 parts colophony, 40 parts guttapercha 150 parts bisulphide of carbon and 60 parts petroleum can be prepared as follows for fastening leather belts and the like The materials, without the bisulphide of carbon, are first of all placed in a bottle standing in boiling water and worked up with petroleum for a few hours When it has thickened suitably the mass is allowed to cool off, the bisulphide of carbon is then added and the whole is allowed to stand for some days, the bottle being frequently shaken. The belting is evenly coated with the cement and passed through warm rollers.

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Deep-Level Rapid Transit

In an age when mechanical achievements of startling character follow one another with increasing rapidity, we learn to be increasingly wary of passing snap judgments upon proposals which, although surprising, are after all merely elaborations of already well tried principles.

In such a category should be placed the recent suggestion of Mr. Bolton that our future rapid transit subways should be built at levels sufficiently deep to avoid interference with existing subways and gas, water and electric mains—built so deeply, in fact, that the lines could be run on tangents and absolutely free from curves straight to their objective points. As a matter of fact, Mr. Bolton suggests a depth of 400 feet, choosing that low level, we presume, with a view to being able to pass, without grades, beneath the rivers and bays which surround Manhattan and intervene between the island and the outlying metropolitan districts.

The only features that would be strikingly novel in such a system would be the great depth below street level and the consequent great length of elevator travel. For the first condition we may find an approximate parallel in the tube system of London, which is built in the underlying clay and at a sufficient depth to be free from interference by the network of water and gas mains and electric cables with which any great city is encumbered. These tubes are served by elevators of large capacity, although the distance of elevator travel is not nearly so great as that proposed for New York. In this connection we think that the depth of 400 feet is excessive and unnecessary, and in the absence of evidence to the contrary, we think that one-half that depth or, at the most, a depth of 300 feet would be sufficient to clear the deep glacial ravine which forms the ancient bed of the North River and extends out to sea.

The point is well made that by going to sufficient depth it is possible to lay out a system of express subway service, with speeds of sixty miles an hour, in which the tracks could radiate from the business centers of Manhattan and run without curve or grade directly to the outlying districts to be served. It is also true that such a system could be built on larger proportions than our present subways and might be operated with much larger and therefore more economical rolling stock. It is true again that the construction of tunnels at this depth would be far cheaper and more expeditious than our present system of "cut-and-cover," with its costly, laborious and exceedingly troublesome interference with street traffic.

We have a precedent for this type of work in the construction of the 12-foot tunnel for carrying the Catskill waters throughout the length of Manhattan Island, which was executed with unusual speed at a low cost and with complete success. In all probability, the costs involved in the question of easement would be very low. Further precedent for cheap tunnel construction in solid rock is found in the Broadway division of the subway below Washington Heights, which is as much as 130 feet below street level at 181st Street. The most serious problem from the operating standpoint would be that of providing adequate elevator facilities. These, of course, would be costly in construction and in operation, since the cars would have to be of unusual dimensions, and the speed would have to be not less than 700 or 800 feet a minute.

The motive for this bold and original scheme is to be found in the enormous rate of increase of the population of New York, and Mr. Bolton is entirely right in stating that as the years pass by it will become increasingly manifest that subway accommodation of the present near-surface type will be inadequate to carry the population of ten million people, which thirty years from now will be living in New York and its immediate suburbs.

Armaments Offset Reparations

The close of a modern war, in which the whole citizen strength of the countries involved must be engaged, is certain, should the war cover a number of years, to leave the victors only less impoverished than the vanquished. Moreover, it is the very irony of fate that, in respect to the late war, the nations which won the decision and exacted reparations should today find themselves borne down by military burdens, which just about equal the cost of the reparations which they have imposed.

By the terms of the Armistice and the Treaty of Versailles, Germany, it will be remembered, was disarmed and forbidden to maintain more than a nominal army and navy, or to engage, on any extended scale, in the manufacture of munitions—which meant, of course, that she was relieved of the huge burden, amounting to hundreds of millions of dollars, which is involved in the maintenance of a big army and navy. Financially speaking, this was helpful to her. On the other hand, she was required to make an annual reparation amounting to about 500 million dollars, plus 26 per cent of the actual value of her exports, the two added together representing a total annual obligation of about 760 million dollars. This is a huge sum, it is true, but it is fairly well offset by the financial relief due to the absence of a great army and navy.

The estimate of a total annual reparations indebtedness of 760 million dollars is that of Senator Borah, who, in an article in *The Nation's Business*, draws attention to the fact that from June 30, 1920, to June 30, 1921, the United States spent over 825 million dollars on its army and navy. For the year 1921-1922, we have made appropriations of 890 million dollars, and this would equal in forty years a little over 33 billion dollars. There is no gainsaying the truth of the Senator's statement that we shall ultimately pay for our army and navy at the present rate an amount equal to the vast reparation claims against Germany.

We may as well look facts squarely in the face. If we, in common with Great Britain, France and Japan, continue to sink enormous sums in the maintenance of fleets and armies sustained on a scale which is out of all proportion to the legitimate international police necessities of these nations, we are placing ourselves under a financial burden that is practically equal, at least in the case of Great Britain and ourselves, to that which has been assumed by Germany.

It is needless to go once more over the well-known arguments against the present extravagant naval and military programs. We have done that frequently and with all the emphasis at our command during the years which have intervened since the Armistice. Fortunately, and thanks to the great forensic ability of Senator Borah and the far-sighted action of the President, there is to be held in this country a congress whose primary object will be the amicable settlement of outstanding international questions with a view to reasonable disarmament. The success of that momentous gathering, whose first session will take place upon Armistice Day, will depend more than anything else upon the degree to which dissimulation gives place to a sincere desire to look impartially at both sides of every question, and upon a resolute determination by all concerned to leave suspicion and fear outside the council chamber.

The Next America's Cup Challenge

According to a recent cable despatch, a challenge will be sent by Sir Thomas Lipton for a series of races for the America's Cup, to be held in 1922. Under existing conditions, the races would be sailed under rules which are intended to prevent the construction of mere racing shells and which, as last year's racing contests proved, failed to do anything of the kind. The rules governing form, beam, draft and sail area were intended to produce a wholesome type of craft which, after it had won or lost off Sandy Hook, could be converted into a staunch cruiser and, as such, be counted on to give several years of service in our own and other waters.

The rule was not, however, a complete failure in this respect, for it worked certain changes in form which were eminently desirable. Thus, the full, long overhangs, characteristic of the scow type, disappeared, and the draft became so moderate that a 70-foot yacht could pass through channels and anchor in harbors without undue fear of grounding. Another good feature of the rule was that it made for greater displacement and a deeper hull, thus providing greater headroom and better cabin accommodations, to say nothing of the improved seaworthiness which comes with increased weight.

To be convinced that the rule failed to prevent the construction of racing machines, it was necessary only to inspect the hulls and spar plans or watch the behavior of "Resolute" and "Shamrock" whenever the wind began to carry any weight in it. For the second time in the history of the last quarter of a century of America's Cup contests, a race was called off because the weather conditions were considered to be too heavy for these frail racing machines to go out and face them. A breeze of 25 to 30 knots is of the kind which used to delight the hearts of the yachting men of the days of Colonel Stephens and of the subsequent era of the two-masted schooners.

It is a matter of history that in the negotiations preceding the "Resolute"-"Shamrock" races, the British challenger tried to persuade the New York Yacht Club to adopt the International rule, in which the actual size of the frames and sheathing of the hull and the character of the spars is specifically designated for every class of racing vessel. The 23-meter "Shamrock," which served as a trial horse for "Shamrock IV," was built under this rule. Not only was she a fast and very "handy" yacht, but her construction throughout was of a staunchness and strength that won the admiration of yachtsmen on this side of the water.

Previous to the races, Mr. Burton came over to this country to try to get the New York Yacht Club to adopt the International rule, which was already in use among the leading yacht-racing nations of the world. The proposal was heartily endorsed by many of the leading yachtsmen, and it looked as though this desirable change would be put through. At the last minute, however, it was rejected, largely because of the violent opposition of the older and reactionary members of the club.

That a rule which calls for strong construction does nothing to take the snap and enthusiasm out of yacht racing has been proved in the series of very interesting races which have recently been concluded in the English Channel between fleets of little 6-meter yachts of American and British design. The boats were built under strict restrictions as to strength, et cetera, and great significance attaches to the contest from the fact that, small as the craft were, they came from the drafting-boards of the most famous and successful designers of big yachts of both countries. The American boats were from designs by Gardner and by Burgess, while the British boats embodied the skill of such men as Fife, Mylne and Nicholson. The five contests were held regardless of weather conditions, and the little boats were sent out in breezes which would have filled the skippers of "Resolute" and "Shamrock IV" with misgiving. With one or two exceptions they came through the series without a mishap, and the fact that they were boats a little stauncher and a little heavier than might have been built under such a rule as governs the America's Cup contest, does not seem to have disturbed any of the skippers or detracted one whit from the keen interest and enthusiasm with which the contest was followed on both sides of the water. The cup was won by the British; but there will be a challenge for next year, and these contests promise to grow yearly in interest and popularity.

We do not know whether any request has been made or will be made that a rule prohibiting the use of absurdly light scantling and spars be adopted for future international races between yachts of 70 feet and upwards. If the matter comes up in connection with a new challenge, we sincerely hope that it will receive most serious consideration. The New York Yacht Club should hesitate to stick to a rule which produces a pair of boats which are afraid to face a summer breeze of more than very moderate weight.

Engineering

Watt's Workshop.—In James Watt's attic workshop at Heathfield Hall, near Birmingham, his tools still lie just as he left them a hundred years ago The owner of Heathfield Hall recently died, and the Watt Centenary Committee now purposes to take steps to preserve this sanctuary of science to the British nation.

An Absorption Plant is being erected on the Dingman No. 1 well near Okotoke, in Alberta, for the purpose of absorbing gasoline from wet gas which is blowing out of the well at the rate of between two and three million feet daily. So heavily is the gas at this well laden with oil that when the tap is taken off and the gas comes roaring out the minute globules of oil form a bluish-gray column projecting several inches above the mouth of the opening

Rhone Development.—The French have some ambitious plans for the development of the Rhone River It is planned to make this waterway into a water transport line that will rival the Rhine and will serve for the irrigation of over 600,000 acres of land Also, 900,000 kilowatts of cheap electric current is to be made available, thus saving coal imports to the value of at least 600 million francs a year River ports will have to be improved or at need, created and joined by rail with the main land arteries of traffic The Rhone River flows west and south from Lake of Geneva to the Mediterranean Sea.

Hongkong's Engineering Projects. — Tenders have already been invited for a reclamation scheme at Hongkong, which involves the reduction of Morrison Hill, at the eastern end of the city, and the filling in of tidelands near the heart of the business section. Some 3,300,000 cubic yards of earth will be handled and about 90 acres of land reclaimed from the sea, in addition to the land made usable by reduction of the hill. The fill to be made, states the *Trans Pacific*, will involve the construction of a sea wall about a mile in length, from which piers and docking facilities of concrete and stone will extend into the sea.

Concrete Masts for Radio.—The Japanese Government is building a powerful radio station at Tokio, one striking feature of which is the reinforced concrete tower for supporting the aerial. The tower is 672 feet high, and of a round, tapering form It measures about 50 feet in diameter at the base, and about four feet at the top. The structure is hollow, of course, with reinforcing bars throughout. The center hollow of the concrete tower is occupied by a steel stairway, which gives access to a balcony near the top, and to four other balconies. The tower was cast by means of a central framework of wood and outside wooden molds, which were shifted upward as the casting progressed

Government Investigation of Building Methods. — With a view to simplifying and even unifying the building codes of the many cities throughout the country, the United States Bureau of Standards has been conducting a most interesting and valuable series of tests on building materials and methods of construction. Brick walls of various kinds have been subjected to compression and fire tests, various kinds of plaster have been made up and subjected to rigid tests, stone, concrete and other building material have been alternately frozen and thawed out until they have cracked, and so on. The intention back of all these tests is to formulate a standard building code which may be adopted by the various municipalities throughout the country It is believed that with a unified building code it becomes possible to lower the cost of building construction. An article on this interesting subject will appear in our columns at an early date.

Humidity and Sound Absorption. — The absorption of sound by a massive rigid wall has been shown to be due in large part to the dissipation of energy in the pores of the reflecting surface. Absorption due to this cause increases with the frequency of the sound. Walls of ordinary plaster have been found to show slight increase in absorption with aging, due presumably to increased porosity. A marked decrease in the absorption by the walls for sounds of high frequency with large increases of humidity in the room, has been observed, according to the *Physical Review* Thus walls of hard gypsum plaster were observed to show a gradual decrease in absorption coefficient amounting to 25 per cent of the original coefficient for the tone 4096 when the relative humidity in the room was increased from 45 per cent to 85 per cent. Weighing of a small sample of the plaster showed that in a humid atmosphere an amount of water equal to one-half of 1 per cent of the weight of the sample was taken up. The closing of the minute pores in this way will account for the decreased sound absorption since the latter decreases with decreasing size of the pores.

Science

A Twelve-Ton Cheese.—A cheese is being manufactured for exhibition at the New York State Fair in Syracuse It will weigh 12 tons and will require 150,000 pounds of milk, or a day s output of 7500 cows.

Meteorite Fall.—A large meteorite fell a short time ago in the grounds of Salop County Asylum, England Dr Hallsworth, one of the medical officers, saw it drop into a bush It was quite hot when picked up and porous and light as pumice-stone

Heavy Storms in Switzerland. — This has been a strange year for Switzerland, first the drought, then the severe snow storms which sent Alpine climbers to the shelter huts. From 20 to 30 inches of snow fell in some places about the 6,000 foot level The thermometer dropped 30 degrees.

Florida Plans to Cultivate Grapes. — The Florida Grape Growers' Association was recently organized at Lakeland, Fla, by sixty-five growers. It is expected that the 1921 crop for the State will amount to 100,000 pounds. Some growers have already contracted for their yield at 35 cents a pound

Ceylon Graphite.—In the Island of Ceylon graphite is found in greater abundance than in any similar sized area in the world The soil and rocks of Ceylon are almost everywhere impregnated with graphite, so that it may be seen covering the surface in the sewers after a rain The supply is practically inexhaustible The peculiarity of Ceylon graphite is its extreme purity

German Chemists Active.—The International Frankfort Fair, recently held in Germany, was remarkable for the number of new chemico-technical products which were placed on exhibition, showing that the manufacturers of that country are intent not only on developing some of their well known products, but are also busy devising new articles with which to build up their trade

Big Bed of Ochre.—A substance resembling brown coal, found within twenty-four miles of Guatemala City, and within fifteen miles of the railroad, has been found to be ochre, which when mixed with water and lime produces a good quality of paint. It is believed by the Department of Foreign and Domestic Commerce that an excellent business might be built up in this material. The supply appears to be very large

New Process of Aluminum Manufacture. — An important discovery, a new method of extracting aluminum from a mineral, which affects the future development of Japanese industry and the formulation of an established air policy of the Japanese Government, is the result of the investigations, which have been carried out by the experiment station on the production of aluminum and its compounds. A great refinery plant driven by electric power will be established at Yoyogi. A project is under contemplation to establish a semi-governmental company for the manufacture of aluminum by the new method, which consists in the electrical treatment of ore and enables the production of aluminum to be increased

Ever-Bearing Orange Tree Found at Tampa. — An ever bearing orange tree which citrus fruit growers believe is destined to revolutionize the orange industry of the state of Florida, if not of the entire country, has been discovered by horticulturists in a small grove at Avon Park, near Tampa, and to protect the specimen its purchasers have placed around it a heavy wire fence twenty feet in height and stationed guards day and night. The tree has been in bearing continuously eight years, but until recently its existence was known only to the owner and several neighbors, who, according to citrus experts, did not realize its value but regarded it merely as a freak of nature A syndicate has been formed to propagate the tree through budding so that a large number of trees may be set out in groves in 1923.

Eclipse of Rhea by the Shadow of Titan.—Occultations of one satellite by another have been rather frequently observed, but there are very few recorded cases of the eclipse of a satellite by another's shadow Webb, in his "Celestial Objects," says there is only one such case on record in connection with the satellites of Jupiter Much interest therefore attaches to the eclipse of Rhea by the shadow of Titan observed by several astronomers April 8, 1921, in consequence of a prediction of the event published the previous January by Messrs. Comrie and Levin in the *Journal* of the British Astronomical Association. Rhea was completely invisible for more than half an hour The observed time of mid-eclipse differed by about 9 minutes from the predicted time. The records of these observations, when fully worked up, should afford a valuable check upon the existing tables of the two satellites of Saturn above mentioned.

Automobile

Gasoline Sources. — According to one authority, about 75 per cent of the gasoline produced in the United States is obtained by direct distillation from the crude About 10 per cent comes from natural and casinghead gas, while only 15 per cent is produced by cracking processes

British Gas Distribution. — Gasoline filling stations for automobiles have not come into use in northeast England and garages use drum storage and hand filling methods in the handling of gasoline A great majority of automobile owners buy their gasoline in drums, keeping it in their private garages, while public garages carry only enough to suffice from day to day

A Mark of Careless Design or assembly is the pool of oil left on the garage floor or roadway by many cars even though they be new and presumably in good repair A floor pan is required in many cases to prevent the floor of the show room from becoming stained, while our highways are black with oil dropped from cars and trucks which use them A dollar a gallon is, one would think a rather high price to pay for road oil, yet that is about what the average motorist pays for oil, a large proportion of which is ultimately deposited on the roadways wherever cars are used

A Instrument Board for installation on top of the steering wheel has been developed and is being manufactured. The speedometer, oil gage, ammeter, ignition and lamp switches and any other indicating mechanism normally used in car operation may be mounted upon it, leaving the space ordinarily used for the instrument board and its connections free for storage compartments for gauntlets, lamp bulbs, spark plugs, curtains or any of the numerous other things that motorists like to carry on the car in a handy place The control board is flush with the steering wheel and all of the indicating devices are directly in the line of vision of the driver, which is certainly a convenience

Gasoline In Smaller Demand.—Price cuts failed to make any material difference in volume of gasoline consumption as the Bureau of Mines refinery statistics for February show that the daily average of gasoline production fell off by one million gallons but the stocks increased by 108,000,000 gallons. The lessened demand was also reflected in increase of 18,000,000 gallons of lubricating oils in reserve with a decreased production of 185,000 gallons. The figures show that there were 680,540,351 gallons on hand at the end of February Exports amounted to 52 497 051 gallons, shipments to insular possessions, 4,580,619, and domestic consumption, 225,195,372 gallons The daily average consumption was 10,079,009 gallons

Drop-Forged Auto-Wheel a Newcomer.—The latest addition to the large variety of automobile wheels is the drop-forged steel wheel which is said to have a number of advantages to warrant its use At the present time, it is made chiefly as a replacement for several types of small, low priced popular cars As compared with wood wheels, the forged steel wheel has the advantage that it consists of only a single piece and therefore has no joint to come apart. Being made of wrought steel, it is practically unbreakable Even the brake drum is made in one piece with the wheel and where it fits to the spokes the joints are nicely rounded so as to prevent the accumulation of mud and dust at these points. All trouble due to the shrinkage of wood is eliminated, and if the wheel is made true in the first place, it should remain true The drop-forged steel wheel is easy to clean and should prove particularly popular in arid sections where wood wheels give trouble owing to shrinkage

New Positive Drive Differential.—A positive-drive differential of the sinusoidal type designed by A. T. Nogrady has been the subject of investigation by various concerns in the industry The differential is fitted with the bevel pinion and side gears in the usual manner However, the bevel gears are fitted with either helical splines or sinusoidal cams that engage with external and internal members, the latter a portion of a member fitted to, or integral with, the main axle shaft. When the traction in either of the rear wheels varies, a cam tends to thrust the differential bevel gear, or side gear against clutch faces on the housing, thereby setting up a frictional load which is transmitted to the cage as a torsional load, and thus to the main axle shafts driven by the side gears. When operating under ordinary conditions, the effect due to the cam is to thrust the side gears inward and away from the provision for positive driving friction, and since the clutching faces are brought to bear one against the other, the thrust is equaled between the inner and outer clutching faces.

Pennsylvania's Roads

The Comprehensive Highway Engineering Plans of the Keystone State

By William McGarry

An engineering feat far greater in total outlay of funds than the Panama Canal is going on quietly in Pennsylvania. Hardly anything is heard of it except when some unlucky motorist gets mired down in a detour over one of the execrable roads that the Keystone State is rushing to replace with what will be the finest highway system in the world.

To date Pennsylvania has built and has in service more than 500 miles of reinforced concrete road built to carry loads of 19,000 pounds, more than 100 miles of road made up of a concrete base with bituminous top, or plain concrete, more than fifty miles of brick road, and an equal stretch of sheet asphalt and new macadam highway.

The proportions here offer a fairly good indication of what the state is attempting to do, for the same ratio of reinforced concrete will govern in the construction of a primary system of highways to cover eventually more than 4,000 miles. At the present writing about 750 miles of this work is under contract and the state, which already claims the world's record for permanent, high speed road building, is out to set a new figure which may stand for years.

With conditions of labor and material markets vastly improved over those existing last year it is a foregone conclusion that the record made in 1920 will be exceeded. In that year despite shortage of labor, lack of materials and increases in cost that forced the abandonment of many similar projects Pennsylvania forged ahead and completed a total of 419.87 miles of durable thoroughfare.

Work had been started at the close of the season last year on an additional 450 miles of highway which the Department was unable to finish because of the coming of winter. It is planned to add to this contracts for a total of 400 miles this summer—in fact, 300 miles already has been let and work has been started. Before the end of the summer many through routes will have been completed and open for service.

The entire cost of the "primary system"—laid out so that it will be possible for a citizen in any part of the states to reach any other section over it—is being borne by the state. For this and other road work in its program the Highway Department has available more than $125,000,000 including bond issues and appropriations, and Federal funds. The bond issue is $50,000,000.

Perhaps the most remarkable feature of the Pennsylvania plan is that every mile on the new primary system of highways was put there only after a thorough survey. This was made over existing routes to determine their availability, locally and to the state at large. In every instance, when it was found that a road by many windings was serving local interests at the expense of the entire state, changes were made in the routing.

In some instances miles of old road were abandoned so far as the new state highway plan is concerned, so that new concrete highways might be laid on lines as nearly straight as possible. There is hardly a road in the system crossing a hill of any consequence in which the grade has not been changed sometimes at heavy cost. The whole thing is worked out by engineers equipped with a knowledge of the pulling power of motor trucks and other traffic for which these roads are being built. Pennsylvania is trying to build a highway system on which no vehicle will ever get stuck save as the result of a mechanical defect. Grades are made passable.

The importance of this will be instantly apparent to motor truck experts who have tried to send heavy loads over some old country highways. It must not be assumed, however, that because the Department is taking advantage of every possible short cut and makes deep cuts through hills that it has ignored the value to the state of preserving the scenic features of its roads. The new system will open to modern motor travel some of the loveliest spots in the state, heretofore closed to those who refuse to take chances on wrecking their cars. It will open also the hunting territories in the western section and hill regions where few cars ventured in previous years.

The primary system does not include many hundreds of miles of road, some of it of the heavy reinforced concrete type, being built in cooperation with county authorities and the Federal government. In general, the state's system includes through highways, and roads connecting the various county seats. Particular attention has been paid in the surveys of through routes used for long distance hauls to the matter of short cuts. An idea of what has been done here is evident from the fact that the Lincoln Highway from Trenton to Philadelphia has been reduced about two and a quarter miles by the elimination of unnecessary curves and loops.

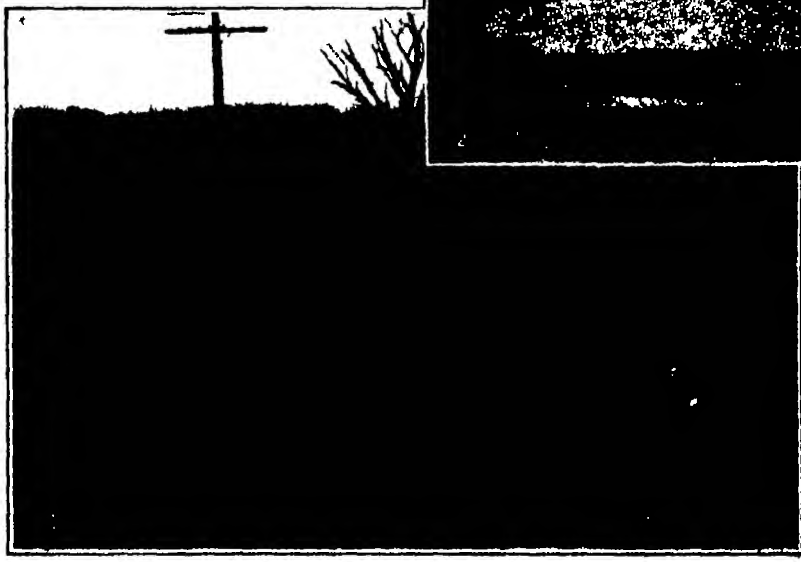
One of the best things about the new system is that it is eliminating many of the most dangerous grade crossings. There were two of these on the Lincoln Highway near Langhorne, Pa. Both have been eliminated in the new survey. The old road looped at this point and made two crossings. By straightening out the loop it was possible to do away with both crossings by a single undercut of the railroad track.

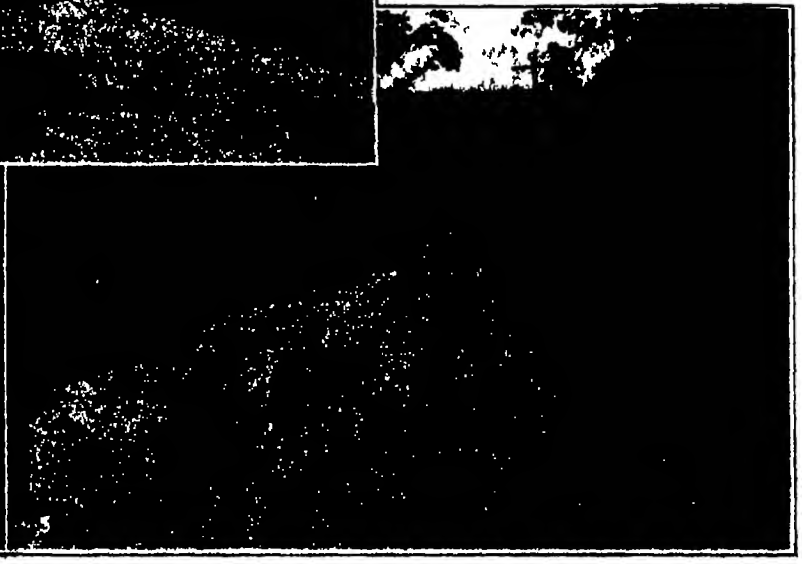
Highway engineers throughout the country have been watching some of the roadbuilding in the Keystone State with unusual interest. For instance, the greater part of the new concrete road from Philadelphia to West Chester, a distance of twenty-one miles, which is nearing completion at this writing, is laid on the old macadam road. This old road was in a bad state of repair. It was leveled off to form the foundation for the concrete. The result is a roadbed of rock and concrete as deep in the aggregate as that of the famous old Roman roads, and one that in the opinion of engineers should last for many years.

Pennsylvania's primary highways for heavy traffic are constructed of an eight inch depth of concrete in the center, tapering to six inches on the sides. Two inches from the top is laid a fifty-six pound wire mesh reinforcement. The specifications require that the road shall withstand a pressure of two thousand pounds to the square inch. Test cylinders are taken by inspectors employed by the State Highway Department every 1500 feet and sent to Harrisburg for examination. Expansion joints are laid on straight runs at the end of each day's run, and at all points of grade or curve where they may be considered necessary.

Last year the concrete was fed into the big mixing machines by gangs of shovelers. Examination of test cylinders, and of sections broken from cracks appearing in the finished road, convinced the State Engineers that most of the failures of the construction were due to the mixture of dirt and occasionally debris in the concrete, as when a gang cleaned up the roadbed preparatory to moving the machine. Accordingly, the specifications this year provide that there shall be no dumping of anything on the subgrade. Cement in bags, heretofore stacked on the grade, is now carried alongside the right of way. Most of the contractors at work on the state highways now use one-ton trucks for the concrete materials. These are loaded in two sections with just the right proportions of stone and sand. These essential materials are dumped directly

(Continued on page 155)





1 A strip of typical Pennsylvania road before the automobile era. 2 A bit of the Lincoln Highway in Fulton County Pa. 3 The same stretch of roadway shown in the first view, as it is today

Pennsylvania's roads before and after taking the treatment prescribed by the State's highway engineers

Left: A detail of the penstock on a grade of almost 100 per cent. *Center:* Anchoring the penstocks. *Right:* The big turbines and generators in actual operation

Views along the line of the Caribou power development

The Caribou Power Plant

By C. W. Geiger

THERE are many unusual features in connection with the new Caribou power plant recently placed in operation in California Aluminum cables, nearly one inch in diameter, transmit the power generated at this plant over double-steel-tower transmission lines 186 miles to the San Francisco Bay distributing area The voltage is 165,000, the greatest voltage that is now carried on any transmission system in the world Lake Almanor, from which the Caribou plant will draw a part of its waters, is the largest artificial power reservoir in the world. The submarine cables that deliver this power to San Francisco from across the bay, are the longest submarine cables of this voltage in the world

The power development area of which the Caribou plant is a unit, begins in Lake Almanor, the source of the Feather River, and ends 75 miles distant, a drop in altitude of more than 4000 feet. The whole project in a nutshell consists in using the waters of the river over and over again during this drop (seven times) for the generation of hydro-electric power, and finally distributing them for irrigation when they have reached the Sacramento Valley levels.

Through the power thus developed there is now furnished more than 300,000 hydro-electric horsepower for California agriculture, business and industry, including mines, factories, gold dredges, railroads, commercial and domestic lighting and coking and heating Practically all of this service has been connected within ten years, and probably within the next fifteen years the Feather River development will reach 640,000 horsepower

Because the Caribou power project was undertaken on the very heels of the cessation of World War hostilities, Central California is saved, this summer, the losses suffered from the power shortage of 1918, 1919, and 1920 Of even larger importance, this great area, with its rapidly increasing population, may go forward confidently in the development of its resources, knowing that, as the need arises, power and more power may and will flow to it from the perpetual reservoirs of the mountains. An interesting sidelight is found in the circumstance that where the Big Bend power house—the largest hydro-electric power plant west of the Mississippi—now stands, the waters of the Feather River were first diverted so that the sands of the river bed might be washed free of their golden weight. The very tunnel used for this purpose eventually became the power-house diversion tunnel

To feed the new Caribou power plant with water was in itself an engineering undertaking of magnitude Tunnel No. 1, 11,200 feet long and with a capacity of 800 cubic feet of water per second, was built to carry the waters of Lake Almanor regulated by two seven foot electrically controlled gates, into Butt Valley, down which they course to Tunnel No. 2, 9200 feet long and with a capacity of 1400 cubic feet of water per second, which leads them to the pressure tunnel. At the bottom of the pressure tunnel, a horizontal tunnel 550 feet long, carries at the present time two sixty-inch steel penstocks which are attached to the pressure tunnel and made water tight by means of a large concrete plug. There is space in the horizontal tunnel for a third pipe of similar dimensions. The pipe lines emerge from the horizontal tunnel and are anchored on the surface of the hillside a distance of 547 feet to a point where they drop vertically into another tunnel known as the "uprise," which is about 550 feet deep About half way down the "uprise" the sixty-inch pipes, by means of large Y-connections, branch into four forty-two-inch pipes. A tunnel running horizontally from the bottom of the 'uprise carries the pipe lines about 500 feet to the surface of the mountainside immediately back of the power house From this point the pipe lines are laid on concrete anchors to four hydraulically operated gate valves which are installed against the rear wall of the power house From these valves the pipe lines lead into the power house, directly to the nozzles of the water wheels. Space has been left in the "uprise" and horizontal tunnels for two more 42 inch pipe lines.

The two 30,000-horsepower units installed at present consist of two overhung impulse wheels, each with 21 buckets, operating under a head of 1008 feet, with a speed of 171 revolutions per minute Each of the buckets of these wheels weighs 1000 pounds. The diameter of the jet which strikes them is eleven inches. These wheels and generator constitute a unit Each unit weighs 290 tons. The revolving element of each unit weighs 170 tons.

The Soap-Nut Tree—A Last Chance

OUR old friend, E. Moulie, who used to be in Florida, but who is now established in San Gabriel, Cal, asks us to assist him in what he believes will be his last distribution of the seed of his beloved soap-nut tree This tree, *Sapindus Muskorossi*, to give it its botanical name, is some fifty feet tall when fully developed, and quite ornamental Its timber resembles orange wood It bears from the age of six years, the average crop being about 200 pounds of nuts per tree These nuts are altogether extraordinary It is the shell of the nut that gives the tree its name, this shell is so rich in saponaceous material that the uncracked nut, right from the tree, can be used with excellent effect to wash the hands This saponine of the hull washes everything from a lace handkerchief to a horse blanket, and is highly beneficial to the human skin as well as to the scalp Inside is found an edible kernel, extremely rich in fats and high in food value

Mr Moulie has spent a good part of his long life (he is in his eighty-first year) in the effort to bring the soap-nut tree into more general cultivation in all places that are suited to it On several occasions, after he has succeeded in accumulating from his own plantations a supply of the nuts sufficient for the purpose, he has conducted free distribution of the seed, with great success

The soap-nut tree will not prosper in regions where the thermometer may be expected to drop below ten degrees, Fahrenheit, and Mr Moulie will not send seeds to such localities. With this exception he is eager to have applications for the seed from any part of the world The last time he distributed the seed he had so many requests that the labor and the expense of filling them nearly swamped him He therefore insists that all applications be accompanied by self-addressed stamped envelope, plus ten cents to cover clerical work, etc *In return each applicant will receive* ten tested soap-nut seeds, which will be sufficient nucleus for an extensive orchard. Mr Moulie suggests that applicants from foreign countries send the ten cents in international postage coupons if United States stamps are not obtainable

The seed will germinate sooner if planted in a hot bed, in a box or pot. The seeds should be planted $1\frac{1}{2}$ inches deep and the soil about it kept moderately moist. When the seedling is about 18 inches tall it can be planted at the point in the open where it is desired to have the tree It must be placed at least 25 feet from any other large tree, and the soil again kept moderately moist until the roots are well settled and the tree has started a healthy growth

It is to be emphasized that Mr Moulie's object in asking us to make this announcement is to spread as widely as possible the cultivation of the tree over which he is so enthusiastic His distribution of 1918 was marked by numerous requests for the nuts in such quantities that it was plainly the intention of the applicants to use them for soap or for food—one lady actually asked for instructions as to their preparation for the table Mr Moulie is giving away seeds, not food, and he is giving them in such a way as to give them the maximum circulation He will not undertake to acknowledge any letters that do not meet his conditions. In particular, do not ask for his nuts by the pound or the bushel, the supply is not unlimited, though Mr Moulie believes it is large enough to insure ten of the tested seeds to everybody who wants them But from the figure which he names in his letter, if you are the 6001st applicant you may not get any seeds.

The out-of-doors elevator that was added to two Los Angeles buildings

How the Elevator Was Added

THE solution of the elevator problem for two public buildings in Los Angeles, two buildings that were built side by side, was an out-of-doors elevator It was put up at the same time that the passageways from one building to the other were installed This type of "open air car is possible owing to the lack of inclement weather and makes it possible for both buildings to be served by one system At each landing there is a door into each building, and the elevator car is fitted with a door at each side In addition to its practicability this style of system enables passengers to view the city, as the buildings are on the summit of a high hill—By *C A Goddard*

A Problem and Its Attempted Solution

The Filing of Papers, as Improved by the Inventive Talent of Our Patent Office

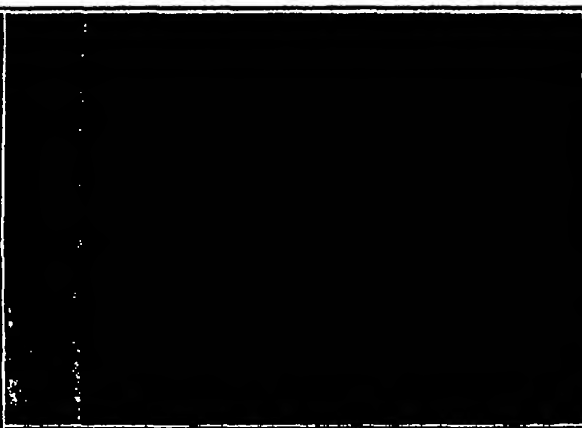
By Wm. I. Wyman, Chief Clerk, U. S. Patent Office.

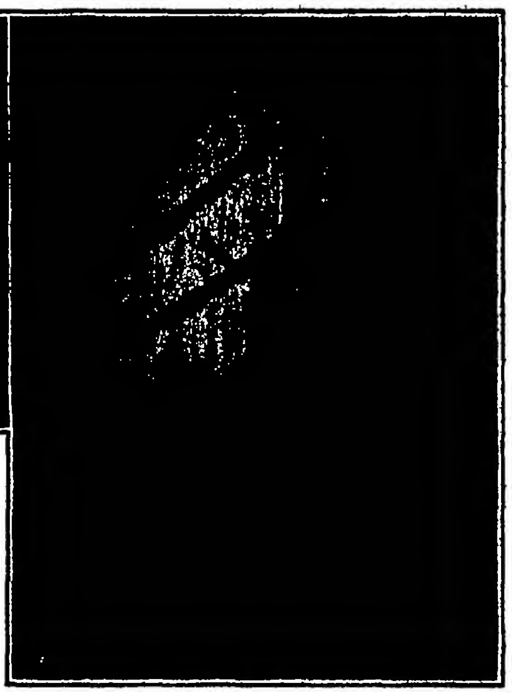
DUE to the sudden and remarkable increase of business before the Patent Office in the spring of 1919, the restricted force of employees therein, and the archaic method of storing copies of patents for sale, a situation arose which caused widespread inconvenience to very important interests. These copies of patents represent, in one body of literature, the nearest approach to a complete history of our industrial advance and to a self-sufficient compendium of all knowledge in the arts of material achievement For practical purposes, they are nearly indispensable, in the investigation of technical problems, in the ascertainment of rights in industrial property, in the conduct of business with the Patent Office, and in litigation before the courts The breaking down of this service became truly a critical question, whose solution could not be postponed without evident aggravation of a situation already almost unendurable.

A slight increase in the force granted by Congress in the last part of 1919 permitted an attempt at relief. In the January 17th number of the SCIENTIFIC AMERICAN appeared an article relating to this subject which running consecutively from No. 1 to No. 250,000.

It is evident, however, that this "bulk" system of storing patents is contradictory of modern methods, that the equipment is inadequate and unscientific, and there is bound to result waste, inaccuracy and inefficiency To keep this system at all effective, constant vigilance is required. For a time after their receipt from the printer the copies stored in this fashion are freshly arranged and illustrate the conditions of the present method of storing at their very best. They stand up well and the numbering on the muslin bands or wrappers is clearly displayed. But this favorable appearance is not for long. The sale of copies as soon as published proceeds very rapidly, the stock is soon depleted, and after repeated "pulling" of copies from a given bin the condition shown in Fig. 1 soon approached. That figure illustrates the condition of the copies from three to four months old, after which time the bundles are "pushed back," i. e., closed up, and straightened It is needless to state that considerable labor is thus entailed and wasted, and that until the copies have been "pushed back," efficient was, and is even still more, as a problem in the Patent Office.

A year's trial with various styles of shelving convinced the writer that the broad idea at the basis of the "individual" case was the germ of any successful attempt to solve the problem that has baffled the officials of the Office for over a generation. With the desideratum of economizing space ever in view, it was finally determined that a solution depended upon a hypothesis diametrically opposite to the one that had hitherto been utilized. Instead of making the dimension of the compartment dependent upon the size of the larger bundles, it was made dependent upon the space occupied by the *smaller* bundles. It was evident that with the smaller bundles determining the size of the individual compartments, practically the entire space of these compartments would be occupied, and that the problem of avoiding waste space was solved. The obvious objection to this scheme was met by another and still more radical departure; the arrangement of open spaces in the same case, where the excess of "fat" copies "squeezed" out by the reduced size of





1 Patent issues four months old, stacked in bulk form. 2. The new vertical case, showing structural arrangements. 3 One of the new cases with a week's issues of patents filed in it.

The old and the new in patent-office filing of printed copies. As soon as funds can be provided, the office hopes to go to the new system entirely

depicted graphically the fallen state to which this service had descended As shown in the pictures accompanying that article the copies of patents were stored on open wooden shelves, wrapped in muslin bands, without means to sustain them in place or properly to identify them, or make certain their position in regular order Lack of equipment and lack of previous opportunity to develop a comprehensive plan had brought the condition depicted to pass.

In the fall of 1919 Commissioner Newton impressed upon the Chief Clerk of the Office the necessity for action and, in view thereof, a comprehensive survey was made and a general procedure outlined It was found that the copies were stored in no sequential order, but in broken groups without numerical relation to each other, from cellar to attic, and in every wing of the building but one This was due to the fact that only such space could be acquired as was released by the Interior Department, which occupied until a few years ago such portions of the building it deemed necessary for its own purposes There were found 37 groups in scattered arrangement, and the attempt was made to reduce the groups to as many units as there were physical divisions to contain them Meanwhile, the copies were straightened out, connected in sequential order, and brought from and carried to all parts of the building to be assembled in proper groupings. Out of the 1,400,000 bundles of patents contained in the building, about 900,000 have thus been finally allocated In a portion of the west balcony, for instance, a wing 270 feet long contains a quarter million bundles of patents in so-called "bulk" form, without a break, "pulling" and accurate placing of numbers are out of question

After a period of trial and study of about a year, the writer devised and installed a storage case departing in principle and in several details from any that had ever previously been tried Cases divided into small compartments to hold copies of but one serial number had been suggested and, in fact, are being used to some extent for this purpose. But it was necessary to discard the installation of further of these units, called "individual" cases, as they possessed grave defects which a limited trial disclosed. Patents vary greatly in thickness, in the great majority of instances from two to ten sheets. There is thus a disparity in the space occupied by any bundle possessing the same serial number, not only on account of the varying thickness of the copies, but also on account of the variation of the sizes of copies. These old "individual" cases were, therefore, designed with horizontal compartments, deep enough to receive [illegible] except the very bulkiest. With the larger bundles determining the size of the individual compartments, necessarily a decided waste of space occurred, the excess of space occupied over the bulk form of storage amounting to about 75 per cent. In spite of this disadvantage and the fact that the upper, exposed copy collected dust, this case was a decided improvement over the "bulk" arrangement. In the latter, three movements are required for the "pulling" of a copy The bundle must be withdrawn outwardly, the copy wanted pulled out at right angles from its wrapper, and the bundle then pushed back. In the "individual" case, each compartment holds but one number, there is a distinct place for each copy, and but one movement is required to "pull." But, as stated before, the installation of the "individual" cases had to be discarded. It literally ate up space, which the individual compartments could be stored as reserve stock.

Fig 2 shows the details of one of these cases. The framing is made of wood, the horizontal shelving being slotted for the reception of galvanized-iron vertical partitions. Some of the units are shown before these partitions are slid into position. One horizontal row of copies has been placed, containing one hundred numbers of about 3000 individual copies. It will be noted that a vertical column of free-space compartments is left to the right of the partitioned shelving. This is for the overflow, which is seen to be occupied by wrapped bundles, and which will comprise about 10 per cent of the contents of the case. Under the worst fortune, the volume of this overflow compartment will represent the wastage of space as compared to the old "bulk" arrangement when the latter is at its best and in "dressed up" condition.

An interesting feature of the construction relates to the vertical partition or divider In the horizontal "individual" case, it had to support the weight of the bundle superposed on it. In this new case it has no structural function and can, therefore, be made very thin, thus saving considerable space. The special novelty in the divider is its trapezoidal form. This permits the grasping of the copies and avoids the expensive operation of cutting away the usual segmental portions for that purpose. Also no metal is wasted, and the facing edge can be hemmed or beaded by a simple mechanical operation.

Fig. 3 illustrates the first case installed from

(Continued on page 155)

Left: Using an elaborate receiving set for reading long-distance radio messages. A kite, carrying a copper wire is flown from the canoe and serves as the aerial. *Center:* A large man-carrying kite being prepared for a flight with a radio aerial. *Right:* A small gas balloon being sent aloft with a copper wire to serve as an aerial

How kites and baloons may be pressed into service for putting up the temporary radio station

The Ubiquitous Radio

By Arthur Lynch

PROGRESS has been remarkably rapid in radio telegraphy, and little less than astounding in radio telephony. By far the greatest fascination in amateur radio has been brought about by the almost unbelievable development of the radio telephone, for, had it not been for this, amateur radio would still be confined to those either understanding the telegraph code or willing to master it through persistent practice. Whereas, up till the recent past the ordinary layman simply heard a jumble of meaningless dots and dashes when listening to radio activities, today the same layman can hear wireless music and regular conversations which need no translation of any kind. The radio telephone has made radio interesting to everyone.

The number of radio telephone stations in regular operation is truly surprising. The reason for this rapid growth is simple enough. Until the practical development of the vacuum tube, which in its main essentials is simply a *form of* incandescent lamp with a number of additional elements introduced into the glass bulb, there has been no simple method of generating radio waves for the transmission of speech. The cumbersome and sputtering arc, the highly expensive and intricate high-frequency alternator, and other old-time methods have been quite out of the reach of the amateur. Today, however, a small radio telephone set, with a range of anything up to say 25 miles, is quite within the reach of the average pocketbook.

In any of our large cities we now come across several radio telephone stations that are owned and operated by amateurs who enjoy themselves by sending out radio concerts and talks that may be picked up by anyone within range and possessing a receiving set. Radio telephones are now being employed in certain sections for spreading the gospel, so to speak. A clergyman, delivering his regular sermon, can broadcast his voice over a wide radius and reach thousands of listeners by means of the present radio telephone.

Music can be broadcasted with little difficulty. In fact, manufacturers of radio apparatus may be expected in the no distant future to maintain regular broadcasting radio telephone stations for the purpose of furnishing music to the users of their receiving sets. At least one company plans to produce a receiving set made in the form of a cabinet phonograph, which, standing in the home of the user, may be tuned for receiving a sermon, speech, music, market reports, Government bulletins and whatnot when radio telephony becomes still more popular.

The United States Government has undertaken the broadcasting of information regarding the conditions of the live-stock and similar markets, in various sections of the country, for the benefit of farmers and live-stock raisers. This service is proving such a success that it will be expanded.

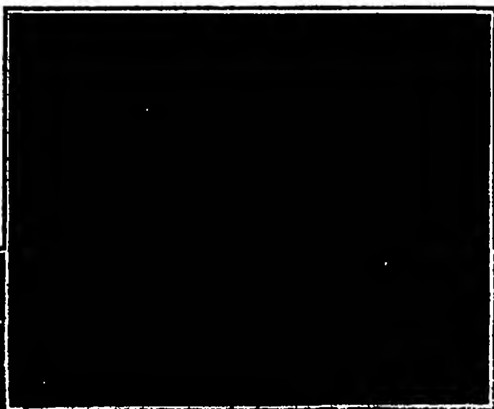
For the benefit of mariners the Bureau of Lighthouses of the Department of Commerce has established radio beacon stations, which are designed to function with as definite reliability and over as great distances as the lights and other signalling devices.

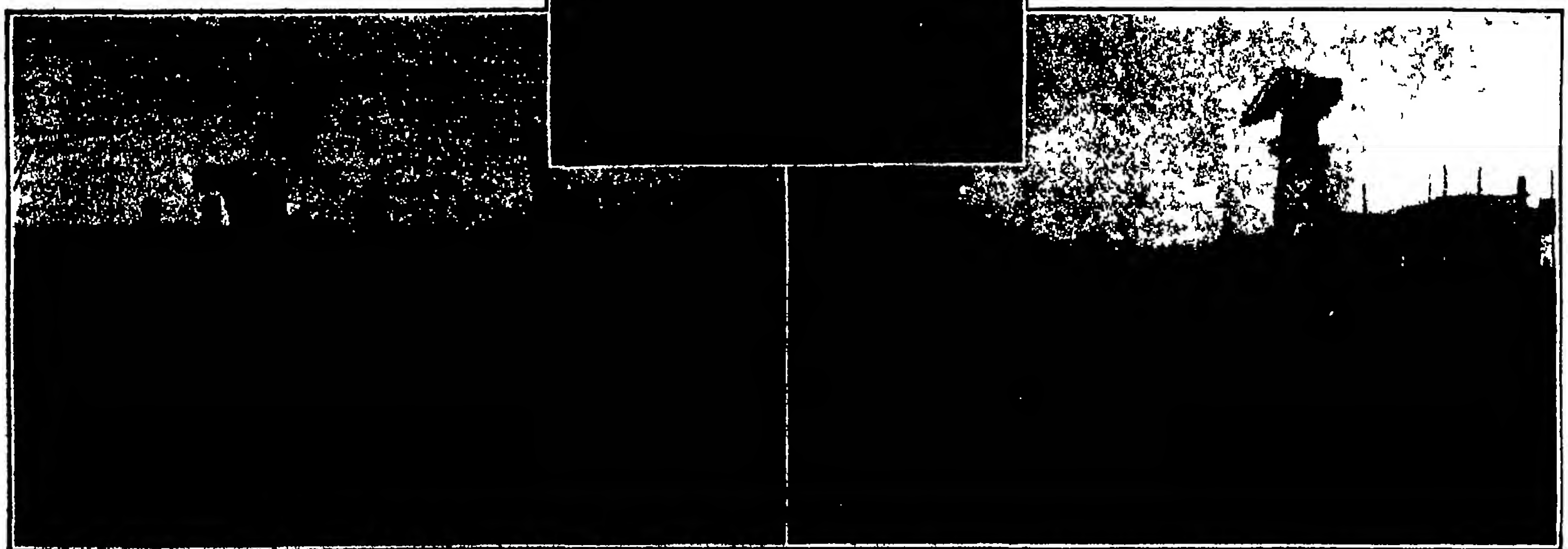
And all the foregoing, be it borne in mind, is available for the layman. There is no special code to master, while the receiving apparatus now available is so simple that anyone can use it. Truly, radio is now available for everybody.

Is it any wonder, then, that we find the camper making use of a radio receiving set to keep in touch with the world's happenings or perhaps to secure a little music for the evening's entertainment? Instead of erecting a large aerial, the camper simply makes use of a large kite or a small balloon which is sent up with a long copper wire that serves as the receiving aerial. For shorter distances the amateur can obtain satisfactory results with a small outdoor aerial or even a dozen turns of wire wound on a square framework, making what is known as a loop aerial which is used indoors.

Trawlers for Battleships

ONE of the most significant transformations in Germany has been the wholesale reorganization of many of her largest industrial plants, formerly devoted to naval and military construction, and their adaptation to meet the peacetime demands of world commerce. We show three pictures taken at the well known German Navy Yard at Wilhelmshaven which indicate this transformation from war to peace activity. One of these represents the building of an 8000-ton commercial steamer upon ways which, formerly, were devoted entirely to cruiser and battleship construction. At this yard, also, there have been built since the Armistice several steel steam trawlers, four of which are shown in the foreground adjacent to the pontoon gate of one of the masonry dry docks. It will be remembered that the Armistice conditions called for the breaking up of several naval vessels that were under construction at the end of the war, and one of our pictures shows a workman engaged in making a long cut through what looks as though it might have been a section of the side or deck of a war vessel.





1. General view of the wharf, where formerly only battleships were built. 2. Part of the work of dismantling a warship, and converting the material to peace-time uses. 3. Construction of an 8000-ton commercial vessel in the old battleship factory

Peace-time affairs at the Wilhelmshaven state wharf, once given over to naval construction

Twenty Miles a Day

Inadequate Terminal Facilities and Their Part in Our Freight Congestion

By John Lathrop

THE automobilist will testify that, in order to average thirty miles per hour for his entire journey from start to finish, he must drive forty or even fifty when he is on the open road. The man who has tried to get from New Jersey to New York by ferry in his car of a Sunday evening will add his testimony to the effect that it is the ferry that governs the time consumed in the attempt, and in no sense the automobiles. Yet, curiously enough, when railroad freight lags behind the schedule which we have laid out for it in our minds, we are inclined to overlook the obvious explanation, and fall back upon the time-honored "car shortage" to solve the riddle for us. The fact is, our railroads are ordinarily handling about as many cars as they can comfortably handle, and any attempt to run more cars with the present facilities can have but the one result of still further lowering the average speed with which the cars move over the tracks. That, under what railroads have become habituated to accept as normal conditions, this average is as low as 15 or 20 miles per day, will surprise many readers, yet this is the fact. Mr Lathrop is decidedly convincing in his argument that we must vastly better our terminal facilities before we shall ever be able to handle freight as it should be handled.—THE EDITOR.

THE day of renewed industrial activity is admitted to be close at hand With it will come again the familiar cry of 'car shortage' with the citation of losses to manufacturers, merchants, farmers and others by reason of delay in receipt of goods, materials and products, and uncertainty caused by the uneconomically slow movement of freight.

I am aware that a vast majority attribute this habitually slow movement of freight to shortage of rolling stock and motive power I affirm here that it is rather due to shortage of terminal facility, in the main, and that, not the purchasing departments of the railways, but only the engineering departments, will be able to correct that conceded defect in our system of national transportation

Every engineer—every scientist, indeed—knows the "neck of the bottle" principle as applied to the flow of railway traffic, that the loaded cars of a railway system may not pass along the lines any faster than the terminals will permit, and that the movement of freight in normal years has for long been slow enough to give haulage by water through the Canal from New York to San Francisco in less time than that required for shipment, trans-continent, by land

Probably not every one who has speculated on these matters has stopped to think that, in the very nature of the case, congestion could not be caused by car shortage—a proposition at once unscientific and absurd Slow movement of freight and congestion are resultants from inadequate terminal facilities, from failure properly to engineer the lines. A failure not to be charged entirely to the railway financiers, but rather to the oncoming of that period wherein railway credit was weak, and capital difficult to be obtained.

We cannot, however, completely exonerate the railway financiers of the past from blame for the inadequacy of the terminals. Engineers have pleaded, and been refused funds, for terminal improvements, in years when the people of the United States (and for that matter of Europe) had abundant capital to sell to our railways for what use the directors wished

With the dawning of the day of revived industry is it not timely to consider by what means the railways may best prepare, and how they may forefend against the continuance of the inordinate delays which have been so heavy a burden on American business and on the people? If the American railway house is to be set in economic order, the engineer will have to be given permission to go full scientific speed ahead, and provide that which will enable the lines to perform their economic functions

It was fifteen years ago that the late James J Hill declared that one billion dollars a year for ten years for improved terminals for American railways were needed to provide reasonable facilities for movement of freight

Such engineering improvements were not provided The engineers hailed Mr Hill's pronunciamento with glad acclaim They knew he had spoken truth. They knew that in no way other than by widening the neck of the bottle could freight movement be accelerated to that which might be regarded as an economical haulage distance per car per day

Instead of giving heed to what Mr Hill said with a world listening, and to what the engineers were saying each to his own superiors, conventions adopted resolutions denouncing "car shortage" and demanding that more cars be bought and more locomotives placed in commission. Even the Interstate Commerce Commission named a sub-commission to hold hearings at stated traffic center points, on "car shortage."

But these hearings developed that, not more cars, but better terminals, were the condition precedent to solving freight congestion, together with some reforms in loading and unloading practices. It came out at last that, were more cars bought, congestion would be worse That that which was needed was to increase the miles per car per day movement. For, the true test of economical haulage is the number of miles per day we move our freight—and not the number of cars in existence which are loaded or ready to be loaded.

The best record of an American railway up to 1915 had been made by the Pennsylvania system—25.6 miles per car per day, a trifle more than one mile an hour About that time, Mr Underwood of the Erie put into operation that road's improved terminals, and soon achieved a per car per day movement of 31 miles.

However, the aggregate of American railways never attained an average of more than 16 to 17 miles per car per day, and in many years the average fell so low as 13 to 14 These freight cars, on a countrywide average of a little more than one-half mile an hour, were so slow moving because (a) there was some delay in loading by consignors, (b) some delay in unloading by consignees, but (c) mainly, because loaded cars ready for haulage and empties ready for loading were detained in terminals where the glut was so great that the railway operating department could not move them out

This is the clearer when one considers that American freight trains move up to 24 miles an hour, or at the rate of 576 miles per 24-hour day, while they are en route between stations. It is not necessarily faster train movement, more cars, more engines, larger trainloads, engines or cars, which must be had per force to increase the movement of freight. It is true that, under a proper co-ordination of all facilities, larger equipment units may be economical. But vastly more vital to betterment of traffic flow is the terminal, which indeed is the *sine qua non* of improvement.

Imagine complaint of slow movement of freight through Harrisburg for the east and west. Imagine one hundred thousand new cars added to the complement of the Pennsylvania system, and fifty thousand of them placed on the tracks at Johnstown to move eastward to seaboard, and the other on the tracks at Philadelphia to move westward through the Harrisburg terminal If the present supply of cars may not be moved through that terminal, how could a hundred thousand additional cars be moved through it? Manifestly, they could not be!

The 3,000 000 freight cars owned by American railways would cost to replace about $6,000,000,000, at least twice the pre-war cost. Their average capacity is about thirty tons. Loaded all at once, they would carry 90,000,000 tons just about 15 miles a day Assume adequate terminal facilities to enable the increase of the per car per day movement to 30 miles—or to 1.25 miles an hour Then 90,000,000 tons would move 30 miles a day, which economically would be the equivalent of moving 180,000,000 tons the present fifteen-mile average. The war period, of course, is excluded as abnormal and in a special class by itself

In other words, we would be economically adding $6,000,000,000 to the capacity of the railways to deliver freight. And in still other words, we could (theoretically) buy not another car or locomotive, put all the money into terminals, and be ahead those six billion dollars, less the extra repairs on the cars as they grew older

It is amazing how generally ignorant the public is in respect of the easily understood fundamentals of transportation. A South Carolina Chamber of Commerce actually appointed a strong, influential committee to induce the railway company to abandon its route around that city for through freight, and bring it into and through that city! "We want the business," they told the General Manager.

But, at the same moment, as a saving incident, the Chamber of Commerce of Syracuse was asking—demanding, indeed—that the through haulage of coal for Ontario points be routed around that city The South Carolina Chamber failed, and the Syracuse Chamber succeeded, in its objective. But the railway officials experienced difficulty in convincing the southern Chamber of the fallacy of its reasoning.

And consider Chicago—greatest rail terminal in the world—with millions of through tonnage dumped into a stagnant pool where congestion foredooms it to remain, sometimes for months, until some leak may be infracted into the dam that it may flow onward to perform its seriously delayed economic function for the Nation Why should freight Duluth to Cleveland, for instance, pass through Evanston and Chicago? And so on *ad infinitum*. Chicago itself would be signally benefited were all through freight routed so as never to enter that city And so would any other city, the terminals of which are glutted with through cars destined to pass onward, the seals unbroken, to points beyond.

It is true that a beginning has been made—classification yards such as those near to Syracuse, and some routing so as to avoid congested terminals. But it is the judgment of railway engineers that the vitality of the issue is not appreciated to one-tenth of its importance by the general mass of railway financiers, operators, legislators and shippers.

Taking Sulfur Out of Coke with Hydrogen

FOR metallurgists the presence of sulfur in coke is very objectionable as is well known and the trouble is likely to become more serious with inferior coal. Most of the sulfur in coke comes from the pyrites, and the pyrites can to a certain extent, be removed by washing the coal. The washing does not affect the organically-bound sulfur, and it barely reduces the sulfur content of the coal by one-half in the best case. Various other means of getting rid of the sulfur have been tried, mainly by converting the sulfur into a compound which can either be volatilized or be eliminated by subsequent leaching Heating of the coal with steam or air, with chlorine, sodium chloride, carbon monoxide or manganese dioxide has been proposed. None of these proposals has been adopted on a large scale, however, because they are either wasteful or too complicated

In analytical practice coal can completely be desulfurized by hydrogen. For that purpose, the powdered coal is mixed with zinc or some other metal which will generate hydrogen on the addition of hydrochloric acid, this hydrogen changes all the sulfur into sulfuretted hydrogen, which escapes. It occurred to Alfred R. Powell, of the United States Bureau of Mines Experiment Station at Pittsburgh, that coal might be purified of sulfur by passing hydrogen through the coking mass. The experiments so far conducted are promising. But the coal must be heated for 8 hours up to 1,000 degrees Centigrade when hydrogen is used, and for longer periods if coke-oven gas is to be utilized, though some of the reactions take place at a temperature of 500 degrees. The experiments as yet have only been made on a very small scale, however, so that the practical difficulties remain an unknown factor It will be interesting to note what is the outcome of these experiments, and what are the practical gains.

Japanese Veneer Paper

An Out-of-the-Way Product and the Simple and Ingenious Manner in Which It Is Made

By Samuel J. Record, Professor of Forest Products, Yale University

EVERYONE perhaps has seen fancy pasteboard boxes covered with a material that looked exactly like wood. One's first thought is likely to be that the grain of the wood has been printed on the paper Upon closer inspection, however, it will be found that there is in reality an extremely thin layer of natural wood glued on to a paper backing. These wood veneers are as thin as tissue paper and a source of wonder as to how they can be produced in such large sheets.

The method of manufacture is the simplest imaginable No expensive or complicated machines enter into its making The delicate veneers are nothing more than thin shavings made by a large hand plane such as carpenters use. This plane is fitted with a blade 3½ inches long and nearly 6 inches wide, but except for the unusual size there is nothing remarkable about the tool In order to secure the necessary pressure and relieve the workman from bearing down on every stroke it is customary to attach above the plane a long spring pole or bow of bamboo. Then about all the workman has to do is to shove the plane back and forth over the wooden block.

The wood commonly used is what is known in Japan as "Kiri." This tree is often planted in America for decorative purposes and is generally known under its botanical name of Paulownia. It produces the lightest lumber in the Far East, is very light colored, easily worked and keeps its shape so well under trying atmospheric conditions that it has a multitude of uses from shoes to furniture, for which no substitute is acceptable The tree grows very rapidly when young and in eight or nine years attains sufficient size to be merchantable. Farmers find it profitable to grow these trees in with their regular crops and sell them when about seven inches in diameter Older timber of slower growth is more highly esteemed but big trees are scarce.

For the production of paper veneers the trees are cut during their dormant period and the logs stored in cellars to prevent drying out. If the wood is allowed to dry it will be difficult to plane When wanted for use the logs are cut into bolts about 24 or 36 inches long, depending on whether the veneers are to be used crosswise or lengthwise of the finished sheet The bolts are quartered by splitting, knotty and defective parts are cut out, and the bark removed. Then without further treatment the quarters are placed in a clamp and the planing begun on one of the split surfaces. Later the block may be turned over and the shavings taken from the other surface in order to preserve the quartered effect.

There is a certain amount of waste at first but as soon as the shavings begin to come off entire they are taken in order and about 50 or 60 of them bundled together. These bundles are then boiled for about 20 minutes in a dilute solution of caustic soda (Na OH) They next are immersed for about five minutes in a solution of ordinary bleaching powder, and then washed in fresh water After washing, they are soaked for a few minutes in a weak solution of sulphuric acid, one part to a thousand, to neutralize excess of alkali and prevent subsequent discoloration

The next step in the process is to spread the shavings on a smooth lacquered board, three feet by four feet in size The edges are joined by overlapping slightly, the surplus water is wiped off, and a thin coating of vegetable glue is uniformly applied Dry paper backing or lining is then applied and smoothed down with a soft brush. Fancy paper with figures of flowers, butterflies, leaves or special designs in bright colors may be used and they show through the diaphanous layer of silvery wood with beautiful effect

There are two stages in the drying process. The paper backed sheets are first hung over a pole and air-dried in the shade After natural drying is finished the sheets are gone over with a steam iron which smoothes out all irregularities and wrinkles. The satiny white veneer can be printed upon and some of it is pressed or calendered into fine corrugations to give a moire, pebbled or other fancy surface

The finished sheets are graded according to grain or other special feature and put into packages of 200 sheets each The weight of 200 sheets is about 5 1/3 pounds Fifteen of these packages make a bale. The price per sheet, two feet by three feet in size, is from 2½ to 6 sen or about half as many cents.

The manufacture of veneer paper in Japan is confind to Yamagata City in the northern part of the island. In 1918 there were 13 manufacturers and the production was 8,250 000 sheets valued at 206,250 yen Later the number of establishments was reduced to 10 and the output in 1919 was 6,500,000 sheets worth 227,500 yen, and in 1920, 7,000,000 sheets valued at 150,000 yen The business furnishes employment to 300 people, of whom 100 are men, 120 are women, and 80 are children

The market for the product is practically confined to Japan, Formosa and Korea, with little or no export trade The paper is used almost exclusively for surfacing decorative boxes and containers Rarely it is also pasted with good effect on the panels of interior sliding doors. It is sometimes used in the United States for covers of souvenir booklets, for menu cards and certain other special uses associated mostly with the lumber industry in an advertising capacity If it could be had in strips of sufficient length it could be used for wall paper and interior decoration to good advantage in this country

The Japanese name for this material is Kiri-gami (Paulownia paper), though some of it is put on the market under the name of Kiri kyogi gami, kyogi meaning veneer Not all of it is made of Paulownia, however, and more highly figured woods, such as cryptomeria and elm, are occasionally employed

Correspondence

The editors are not responsible for statements made in the correspondence column Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A New View of Einstein

To the Editor of the SCIENTIFIC AMERICAN

I have read with much care Einstein's book on "Relativity" I regard Einstein as a humorist of high order, and shall take much interest in reading the remarks of your essayists to show that they understand him and belong to the immortal twelve whom he acknowledges. Singular coincidence—another great but serious Leader conceded He had 12 disciples who understood him (Was there something racial and imitative in this?)

Percival Lowell was a great humorist and gained advertisement by claiming to make proofs of the inhabitation of Mars. I discovered that Percival was a humorist by reading all his printed works. King Solomon was a humorist—behind the scenes he nearly rolled off the throne laughing at his own decision on dividing the child. (How few understand this) The Delphians were humorists. (What else?) Thales was a humorist. (See his joke about falling into a ditch while watching the heavens.) The Druids were humorists. (See their jokes about the moon as heaven) Various humorists pretend to be trying to communicate with people on Mars. The author of "Cardiff Giant" was one of the humorists. Recall David Starr Jordan's story and joke about the cat and how all the wise men of the United States fell to it.

All mathematics, where it is not founded upon senses and the concrete, and where it does not keep true to the criterion of (common) sense has a border edge where you step into the absurd, unreal and impossible—(surds and transcendentals)—because mathematics is but a human invention by which we try to comprehend and measure a world without us *which has no mathematics*. Stepping from the concrete into the absurd and back again is "the humor of it" of the mathematical wise or *witty* man

This feat Einstein does to advertise himself by his wit. He talks seriously on the concrete, then goes into the abstract or absolute, invents and adapts a little mathematics to go with it, then comes back into the concrete with a whole lot of new absurdities. (See clocks, bodies moving lengthwise, etc)

His wit consists in stepping back and forth from the concrete and absolute so adroitly that most people fail to note the transition It makes a droll result, and really is a fine wit. Having this "explanation" of "Einstein," read his "Relativity" again with the sense that you are perusing the work of a humorist, and you will see that your eyes are opened and that you understand "Einstein"

Providence, R I MINER H. PADDOCK

Lightning in the South

To the Editor of the SCIENTIFIC AMERICAN

I was much interested in the article on "Lightning" by J Lachenbruch in the SCIENTIFIC AMERICAN of July 9th Here in southern Alabama during July and August, we have thunder showers of more or less violence nearly every day

Some phases of these storms are different from what I have observed in the North—at least in the Middle and Northeastern States. We have here the usual "chain" lightning which strikes preferably the yellow pines which have heavy tap roots. I have seen it stated that in the mountains of the Northwest the trees are not often killed by a discharge I have never seen any trees here but what were killed outright Sometimes clouds accompanying a thunder shower will pass over with a continuous humming growl and not necessarily with any perceptible discharge of either electricity or rain. The growl or murmur is apparently electrical as wind sufficient to produce the effect would be evident in disturbance of the cloud mass.

Mr Lachenbruch speaks of 'sheet' lightning as being only the reflection of distant chain lightning That undoubtedly is often so, but our experience with storms here may explain cases where that view is insufficient Down here in midsummer, or at the height of our electrical period, we have storms in which the whole cloud will glow at very frequent intervals with great intensity like a mercury vapor lamp The color is usually white or yellowish but I have seen it when it glowed a light rose color, perhaps tinged with violet. An approaching or receding storm makes a fine sight when this glow passes from one part to another of its piled-up masses.

That this glow is not merely a surface electrification but is of the particles of the whole mass seems true because sometimes when such a cloud approaches the earth closely enough to become a fog the whole atmosphere around one seems on fire When near the earth such displays usually end with a bang" which, by the way, one is glad to hear as a proof of still being alive! When the clouds are higher in the air the glow will spread through one cloud to another with only a more or less continuous growl but louder and more distinct than the humming noise in the case I first mentioned Almost every evening at this time of year one can see on the horizon, clouds burst into this electrical glow resembling the so-called "sheet' lightning so much that I have often wondered whether the latter might not frequently be mistaken for the glow lightning. In the North the glow form might be present only in modified intensity in the higher cloud masses which would only be visible at a distance as intervening heavy clouds would in that case shut it out from below until the storm was some distance off W RUSSELL JONES.

Satsuma, Ala

The Speed of Birds in Flight

To the Editor of the SCIENTIFIC AMERICAN

I have just read an editorial in the recent issue of your classic paper on the above subject, and I have one observation which may be of interest. Some years ago I noticed the speed of the flight of a wild duck in its course down one of the large western rivers. I was on a transcontinental train going down grade along the bank of the river The river was straight for a considerable distance It was late in the afternoon, the duck was alone in its flight, and I had the impression that it was working at about its maximum speed I had plenty of time to observe its speed as it flew parallel to the train for three miles, and at very slightly greater speed The occurrence was so unusual (to me), and the opportunity such a good one, that I made careful note of the relative speeds of the duck and the train I took the time of the train in passing from one mile post to another and found the speed of the train was at the rate of fifty miles per hour I carefully noted the leaves of the trees for any indications as to direction of the wind, but concluded that there was no wind My conclusion was that the duck was flying through the air at a rate of from fifty to fifty five miles per hour The size of the duck was such that it might have been a mallard, but I could not identify it positively W M WHITE.

Milwaukee, Wis.

The Story of the Rail

How Scientific Tests Are Solving Some Outstanding Transportation Difficulties

By George H. Dacy

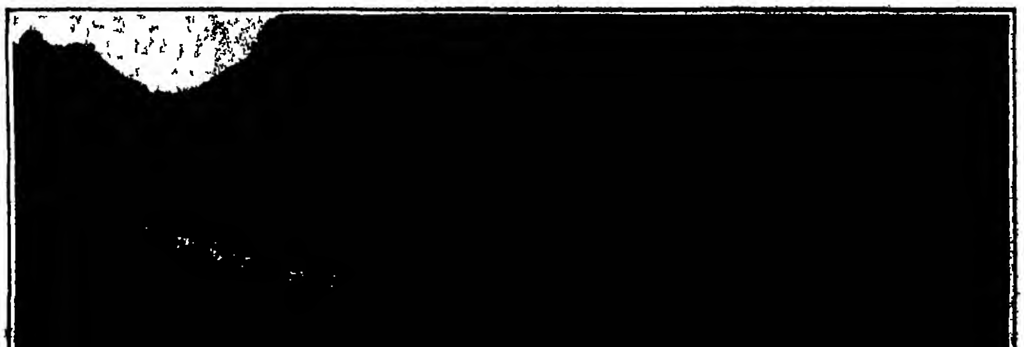
SINCE the inception of modern rolling stock, more powerful locomotives and improved roadbeds, the universal tendency has been for the railroads to overload freight cars without proper and complete knowledge concerning the stress and strain and wear and tear which the various types of chilled iron car wheels would withstand Annually, innumerable failures of car wheels and even serious wrecks are due to this lack of the scientific standardization of the car wheel industry Evidently, the railroads have been too busy to tackle and solve the problem as they largely have followed theoretical guesswork as a guide in many of their car wheel activities The transportation department of the University of Illinois College of Engineering has set out to solve these problems as well as many others relating to railroad transportation riddles In some of this experimental work, the college authorities are working in cooperation with the American Society of Civil Engineers and the American Railroad Engineers' Association, while in others the Illinois institution is doing free lance research work.

Close-up phantom view of the mechanism that conveys the impression of the rail strain from the rail to the recording apparatus

Some of the railroad track studies have been in progress seven years and are the most complete of their kind ever attempted and consummated

The car wheel tests at present in progress are designed for the definite determination of the various stresses set up in different parts of the car wheel when the brake is applied on a long mountain grade This strain often is sufficient to disrupt and collapse the wheel and many accidents and wrecks on such grades are directly due to the lack of standardization and complete knowledge concerning the responses which the individual wheels will make to a wide range of stresses and strains Stress and strain compensations in many instances, are responsible for holding car wheels together, the disruptive operations of one agent counterbalancing those of another When the chilled iron car wheels are forced on the car axle—they must fit very tight—an enormous stress is produced at the wheel center Other stresses are developed with the application of the brakes Chilled iron wheels are preferred by many railroads to all-steel wheels, because they wear better on steel rails and because they are cheaper

The Illinois tests involve complete study of the strains developed in the wheel when the car load is transferred to the rails through the wheels, the compensating stresses which are produced in the wheels, and the loads which would collapse flanges under a wide range of conditions. The purpose of these tests is to ascertain positively what stresses are set up in the wheels under service, what shape and design of wheels will best meet these requirements, how thick the wheels should be, how heavy and what proportion of iron is necessary in the construction of the wheels to make them safe and durable These car wheel tests at Champaign, Illinois, have already consumed five years' work as, at the outset, the investigators were working on new problems. There were no precedents to steer their experiments by They had to devise and develop original testing machines which, under laboratory conditions, would permit of duplicating the wear, service and traffic conditions to which the car wheels would be subjected in actual service The measurement of such stresses is a slow, time-exhausting process and it takes long periods of untiring effort to attain satisfactory and permanent results. In the test work, electrical contacts and thermo-couples are employed to determine the temperature responses at all parts of the wheel under varying types of service, load, grade and braking Special strain gages are used to measure the stretch and strain produced in the wheels in both the radial and circumferential directions



The rail-recording device, that gives smoked-glass graphs of the stress and strain produced by the passage of each wheel of the train

The investigations of railroad tracks are performed partly in the laboratory and partly under actual field and service conditions Very detailed studies of the rail, railroad crosstie, rail joint and ballast have been made. Under actual service conditions, all types of locomotives and cars have been studied operating at speeds ranging from one mile to sixty miles an hour Special recording instruments have been devised which are attached directly to the rail and by the use of glass-smoked disks and a recording pencil, a line is drawn on the disks when the rail is subjected to the strain of the load distributed over it when a locomotive or train wheel passes The deviations of this line from a true circle are accurate indications of the stress, compression and stretch induced in the rail when subjected to the burden In exceptional instances, a stress of as high as 50,000 pounds a square inch has been developed in the rail by the action of certain locomotive wheels. It is worthy of special mention that more than 400,000 microscopic readings were recorded during the summer of 1920 in the field investigational operations. Track tests were made on the Illinois Central Railroad near Champaign, on the Chicago, Milwaukee & St. Paul Railroad north of Chicago, on the Topeka and Santa Fe Railroad in Iowa and New Mexico, and on the Delaware, Lackawanna and Western Railroad in New Jersey in order to obtain results of countrywide application.

Research studies have been made of different types of locomotives to determine if they were properly designed and counterbalanced from a technical and scientific standpoint. Thorough studies have been made of why rails break under service and the results will be of great value in preventing the repetition of such accidents. The correct spacing of the drivers and other wheels has been investigated—up to a limit of six feet, the closer the wheels are the better for the rail. The effect of flat spots on car wheels and their action on the rail have been thoroughly investigated. Flat spots are particularly injurious to rails where the brakes of the car are abruptly and tightly applied, while such actions increase the damage to the wheel. Briefly, these detailed tests will result in the potential standardization of chilled, iron car-wheel design and steel rail utilization. In the future as a result of this experimental work, greater efficiency will obtain from the service of railroad trackage and car wheels.

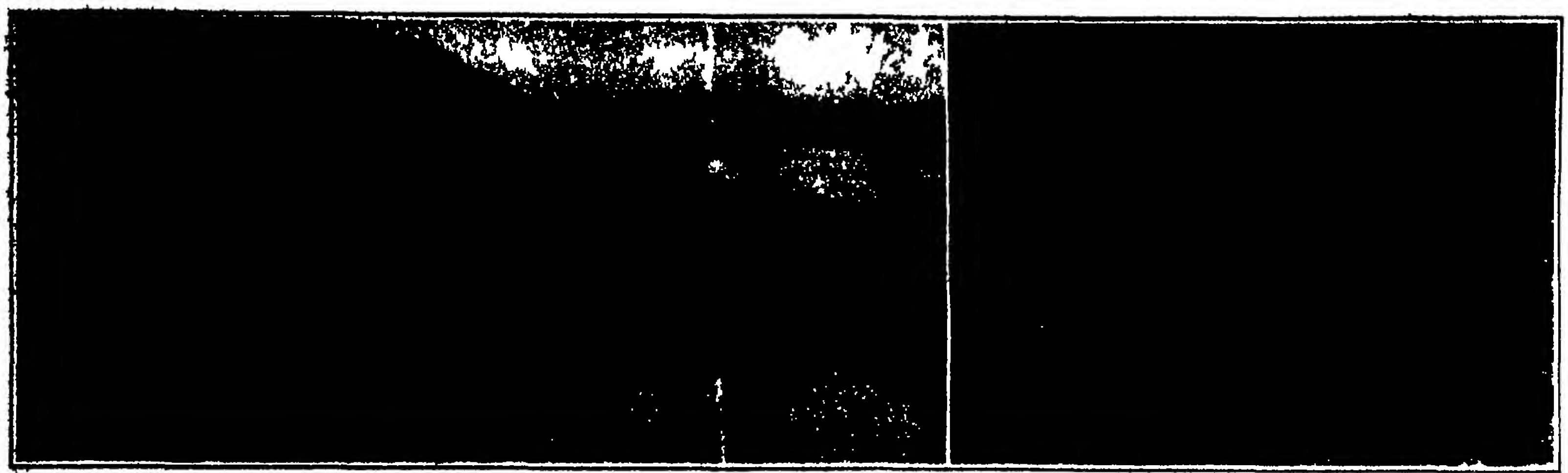
The question of how heavy rails should be to withstand the traffic of different weights and types of locomotives has been covered and an intensive investigation of all types of rail joints to ascertain the proper length and shape has been completed. The railroad ties have not been neglected as they have been carefully scrutinized from all possible angles regarding their bend, their bearing in ballast, what happens if the ties are not tamped thoroughly or are tamped too much in one spot. Complete data have been obtained concerning the most efficient designs for steel and reenforced, concrete ties. Scientific observation of the ballast have included how the pressure is distributed downward from the tie through the ballast and laterally through the roadbed foundation so as to decide the exact amount of ballast essential for best results, particularly in cases where the roadbed is soft. For ordinary light traffic, gravel and cinders generally constitute satisfactory ballast, but where the traffic is heavy, crushed rock and broken stone are preferable. These tests will be continued and carefully rechecked until absolutely reliable data are obtained in conclusive amounts

Explosions Caused by Aluminum Dust

THAT aluminum dust may be the cause of a serious explosion, similar to that caused by coal dust or other materials, is evident from a description of the circumstances under which a fatal explosion of aluminum dust took place in a finishing department of a plant making aluminum utensils.

The finish was obtained by polishing the utensils on lathes, the dust being collected in hoods feeding into a duct running under the bench and leading to an exhaust fan. This fan delivered the dust into a vertical pipe which had its discharge on the roof of the building. The explosion was due to a piece of No 7 B and S. gage iron wire which had somehow got into the discharge pipe and had come into contact with the blades of the fan, thereby, no doubt, creating a spark which ignited the dust. The explosion was fatal to the operatives working near the blind end of the suction pipe.

The new ventilating system provides for induced ventilation. The hoods collecting the dust from each brush are led independently outside the building, and clean air under pressure is provided from a pressure fan through a duct again running under the bench, this air being blown into the exhaust ducts leading from the lathes, inducing the necessary depression in the hoods. The dust is kept from contact with moving machinery and the danger of an explosion is practically eliminated.



Left: The rocks that were upheaved when Mount Tom was formed It is in these rocks that the dinosaur tracks are found *Right* One of the prints considerably longer and immensely broader than a human foot

The prehistoric Connecticut Yankee was a dinosaur, if the record of the rocks is to be trusted

Our Prehistoric Inhabitants

THE existence of tracks of dinosaurs in the Triassic sandstones of the Connecticut Valley has been known to geologists and to readers of geological literature for years Many of us have seen such impressions contained in slabs of sandstone removed from the places where they were discovered and placed on exhibition in museums and the tracks have often been pictured in books on geological subjects Few of us realize however just how these impressions, made millions of years ago on the bottoms of broad river courses and along their banks by these prehistoric animals, came to be exposed to the inquiring eye of the observer today

Ten millions of years ago, the Triassic or lower of the three great divisions of the system of fossiliferous rocks which make up the Mesozoic series was formed and at that time there was no Mt Tom or Mt Holyoke to add to the beauty of the Connecticut Valley In fact, the stream which we now call the Connecticut River did not exist, but in its place was a shallow stream bed which probably followed its present course Some prehistoric animal which scientists have now come to believe was the dinosaur splashed through this river flood plain and left his tracks on the soft muddy, rippled bottom Eight millions of years ago during what is known as the Jurassic period the earth heaved, the Triassic sandstone was broken into segments and tilted up and the foundations of mountain peaks now known as Mt Tom and Mt Holyoke were tilted into their present attitude They were eroded and base levelled during the Cretaceous Period and following this the present valley of the Connecticut River was formed Our photographs show this softly rippled Triassic sandstone, now hardened into a rocky formation sloping down to the present Connecticut River, and here and there on this rippling surface may be seen slight depressions which resemble in outline the tracks of a huge three toed bird Some of them are slightly longer than the average man's foot and over twice as broad Among these larger impressions is an imprint (about as large as a three fingered human hand with the middle finger extra long) which may possibly be the track of a baby dinosaur or more probably that of a smaller species of the same general character

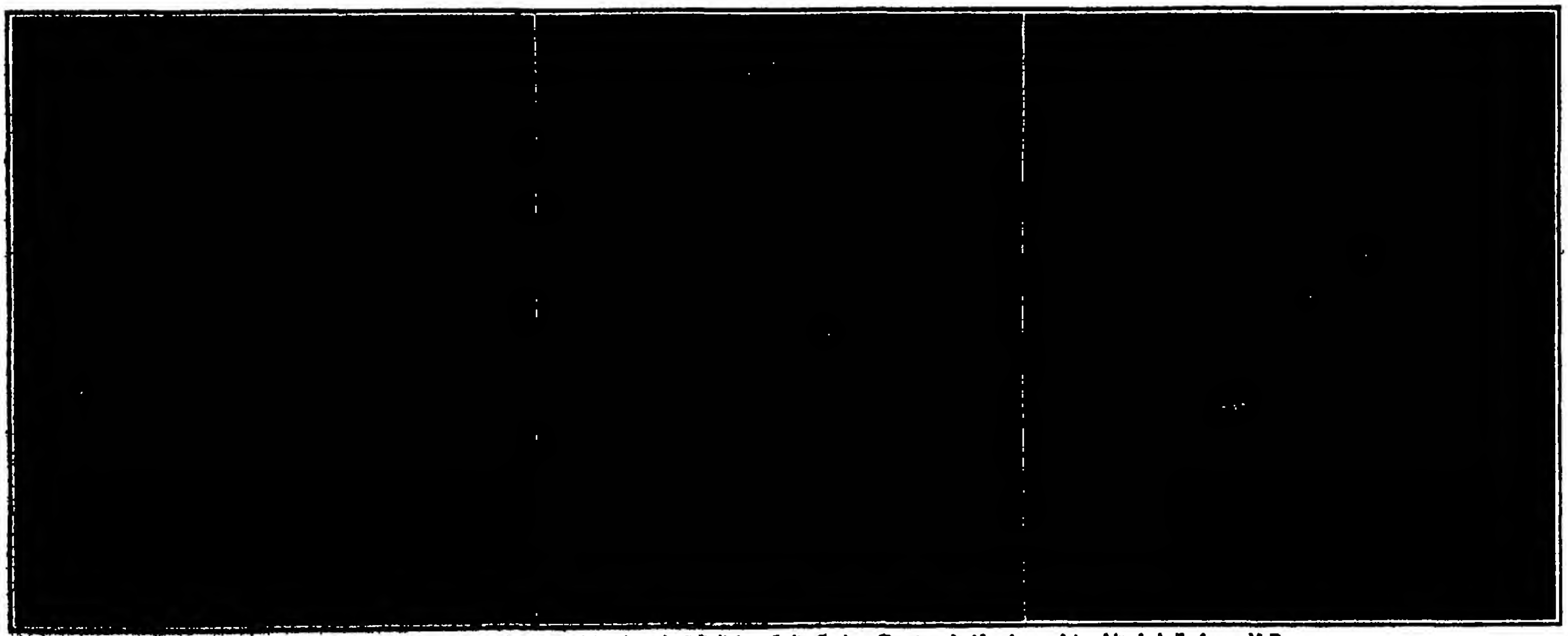
It is interesting to note in this connection that the members of the dinosaur family were not all colossal monsters From skeletons of these animals which have been unearthed paleontologists have established the fact that dinosaurs ranged in size from the height of a chicken to the nineteen foot monstrosities which we ordinarily associate with the name of this prehistoric reptile

From the position of these tracks on the rocks and skeletons discovered scientists believe that dinosaurs were two legged not four legged animals and that in bodily outline and method of progression they resembled somewhat the kangaroo The larger animals had a long sweeping stride and it takes a long legged man to step from one of their footprints in the rock to the next Series of six or eight successive steps may be traced but the trail soon disappears under a stratum of rock which may be removed in the future or has been obliterated by the action of the weather or the thoughtless destructiveness of picnickers who have built their camp fires over this hieroglyphic record of dinosaurian tribes which lived long before the human species made its appearance upon the stage of geological time —By *C M Lewis*

Old Peruvian Surgery

IN the American Museum of Natural History are preserved some skulls which show some daring examples of surgery practised by the Peruvian surgeons in the time of the Incas The most remarkable example is a trephined skull which shows a clear case of trephining before death This is considered as evidence *of a remarkable knowledge of surgery among an* aboriginal people The skull was obtained from the Incan cemetery in the valley of Yucay and was for many years in a well known collection in Peru where it was visited by celebrated surgeons who found the operation was not performed with a saw but with a burin or tool like that used by engravers The opening is 58 one hundredths of an inch wide and 70 one-hundredths of an inch long The date of the skull *has not been definitely determined but there is no* doubt of its ante-Columbian date It is thought that the patient survived the operation anywhere from seven to fifteen days The operation consisted of four linear incisions as shown in the engraving The job was a good one and the bone was removed to the dura mater The amount of bone removed was about equal to that which would have been removed by the use of a modern circular trephining saw There was no fracture of the bone therefore this surgical act was preceded by a diagnosis It is believed that for some days before the operation there had been an effusion of blood under the dura mater Whether the original or the modern diagnoses were true or false we conclude that there was in Peru before the European epoch an advanced surgery

In addition we show an artificial deformation exhibited by a flattened skull from Bolivia This is also in the American Museum of Natural History



Right: Artificially deformed skull of an adult of ancient Bolivia. *Left, Center:* Front and side views of trephined skulls from old Peru

Samples of Incan surgery, as practiced 500 years or more ago

With the Engineers of Industry

A Department Devoted to the Physical Problems of the Plant Executive

This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work. The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.

The Vacuum Cleaner in the Factory

THE vacuum cleaner idea has at last invaded the up-to-date factory, and is proving just as much of a time- and labor-saver there as it has proved in the home. The factory vacuum cleaner must of necessity be a heavier machine than the domestic cleaner. The present practice is either to have a portable cleaner mounted on a four wheeled truck and available in any part of the factory, or to install a vacuum pump in some part of the factory building connected by pipes to the hose and nozzle in any other part. The collector tank, in the latter case, can be placed out of doors and in such a position that it can be emptied directly into a motor truck, wagon or dump car for ready removal.

Aside from speeding up the work of sweeping and cleaning, the vacuum cleaner does a far better job. It does not raise the dust as in ordinary sweeping, in fact, the dirt and dust are removed and not scattered in every direction. One man and a large vacuum cleaner installation can keep the average factory clean, safe and healthful.

Conservation of Steel Stacks Weakened by Corrosion

THE conservation of self-supporting steel stacks, which have corroded to the danger point, by encasing them with concrete has become a well-established practice. Engineers and owners of power plants should know of it. To demolish an otherwise serviceable stack simply because the steel shell has lost its strength by corrosion, when at comparatively small expense and without even shutting down the boilers, it may be converted into a permanent concrete stack would, in the light of present knowledge, be a great mistake.

Rather than tear down a steel stack, which was in condition requiring renewal, causing shut down of the pumping station at South Works, Illinois Steel Co., South Chicago, 1919, it was decided to use the cement gun in reconstructing the stack. By coating the outside with reinforced cement gun concrete, a new self-supporting stack has been built upon the existing foundation.

This steel stack was 175 feet high by 9 feet diameter. A reinforcing network of sufficient strength to make the new stack self supporting without any help from the existing stack was built up of rods and wire mesh and secured to the existing foundation bolts. A cement-gun was then used to shoot guncrete or gunite, as it is variously called, through the reinforcing mesh against the existing steel shell to the required thickness. A mixture of sand and cement hydrated in the nozzle was applied with an air pressure of about 35 pounds. The guncrete is 18 inches thick at the base, tapers rapidly to 6 inches just above the bell base and then gradually decreases to 4 inches at the top.

The cement-gun remained on the ground. The dry mixture of sand and cement was blown through the hose by air from a compressor working at about 50 pounds pressure. Water was forced through the water hose of relatively small size but considerable length and at a pressure great enough to give a pressure at the nozzle in excess of the air pressure. The operator worked upward from the bottom, finishing as he went, so that at the end he was 175 feet above the gun and material was forced up to him at the nozzle at that point.

All the work was done without interrupting the use of the stack. The guncrete was applied when the stack was too hot to permit holding the hand against it. The breeching extending from the side of the boiler house to the stack was also encased with 3 inches of guncrete while it was so hot that water thrown against it boiled. The guncrete was kept thoroughly sprinkled until set. The effect of the hot stack seemed to be that of steam curing and after being in use for nearly 3 years the guncrete is everywhere sound and shows no cracks.

Some Facts About Shop Lighting

BLINDFOLD even the most skilled mechanic and he is helpless. Any piece of work which he attempted to do would be spoiled, and he would be liable to injure himself or some other work man.

Workmen in a poorly lighted factory are, in effect, partially blindfolded. The process of manufacturing goes on, but certainly not as efficiently as if adequate light were provided. Yet many manufacturers who supply their employees with the best of tools and equipment fail to consider the importance of the worker's eyes and the handicap of poor lighting. The efficiency of the workman determines the efficiency of the machine. Adequate illumination is an essential factor in securing high efficiency of the workman.

Inadequate and improper illumination increases the probability of accidents. A careful analysis of 91,000 accidents showed that about 24 per cent were due wholly or in part to poor lighting.

While most employers and employees are familiar with the dangers to the eyes from mechanical injury, very few are aware of the harm done by poor lighting. Impairment of vision is a slow process, and it may take months and even years before the individual becomes aware of it. Fatigue and eye-strain, caused by improper lighting, will lead to nearsightedness, then to a gradual decrease of vision, and possibly to total blindness.

Good lighting is an investment, states the National Safety Council, not an expenditure. In a plant which is properly illuminated accidents are less frequent, the employees work more efficiently and make fewer mistakes, a closer and better supervision of the men is possible, and the employees are contented and more stable in employment because of the orderly and pleasant surroundings which are sure to result from good lighting.

Adequate daylight illumination, properly applied, is the ideal light for the eyes. Light from above is generally better than light from side windows only. Skylights and monitor windows should, therefore, be provided wherever possible. Large window areas, equipped when necessary with awnings, window shades or blinds, and diffusive or refractive glass, together with light interiors, are desirable in every work place.

The light should be adequate for each employee. The illumination intensity should be at least twice the minimum specified for artificial lighting.

The skylights and windows should be so spaced and located that daylight conditions are fairly uniform over the working area. Saw tooth roof construction gives an ideal daylight distribution.

The intensities of daylight should be such that artificial light will be required only during those portions of the day when it is naturally considered necessary.

To avoid glare due to the sun's rays and light from the sky shining directly into the eyes, window shades or other means should be provided where necessary.

Ceilings and upper portions of walls should be kept a light color. The lower portions of the walls may be darker, to rest the eyes.

Machines and work benches should be placed to secure the best light available. Benches at right angles to wall will often be found to improve lighting conditions. Close machine work and bench work should be placed nearest the windows and the coarser work in center of room. Machines should be so placed that the light reaches the workman from the side and falls naturally on the work, and that operators, benches, and machines interfere as little as possible with the proper distribution of light to others farther from the windows. Lighting is improved by the removal of overhead belting.

Wired glass is recommended for practically all factory and mill windows where prisms are not required. Prism glass is of advantage where the windows are obstructed by buildings, especially if the room is deep. By its use a better distribution of the light over the floor area is possible. Wired glass should be used in all skylights as a safeguard against breakage. Ribbed glass gives better diffusion than plain glass, in vertical windows it should generally be placed with the ribs horizontal, and will then act somewhat like prism glass.

Artificial light is required in factories and shops, on an average, about 20 per cent of the total working hours, not including overtime or night work. Where night work is carried on, the artificial lighting problem must, of course, receive particularly careful consideration. The development of new and improved types of lights, in many sizes, makes it possible to secure satisfactory and adequate illumination in any industry and under varying conditions.

In the *direct lighting* system, which is most commonly employed, the light from the lamp shines directly on the object to be illuminated. Reflectors or enclosing globes are used to improve the light distribution, and to diffuse the direct rays from the lamp. With open reflectors, the glare from the lamp and reflectors is minimized by frosting the lamp or interposing another diffusing medium and by the use of reflectors of large area.

In *indirect lighting*, the work is illuminated by light reflected from the ceiling and walls. The glare from the lamp is avoided, the reflected glare from glossy surfaces is reduced, and shadows are greatly softened. Indirect lighting is the nearest approach to daylight. The new developments in incandescent lamps of high efficiency have reduced the operating cost of indirect lighting and increased its use.

Semi-indirect lighting combines the features of direct and indirect lighting systems. An opal glass bowl is used below the unit and permits a part of the direct light to pass through, while other rays are reflected to the ceiling and walls. By varying the density of the opal glass bowl, various degrees of direct and indirect illumination may be secured. This system is rarely used for industrial lighting but principally for ornamental purposes.

Local lighting alone should never be used, except for a few special operations. A moderate degree of general lighting from overhead lamps should be supplied even if local illumination is necessary at the machines, but whenever possible a system of general illumination only should be used, as this gives the most satisfactory results. Bare lamps should never be used as local lights at machines because they tend to blind the workman and in most cases shine more strongly into the eyes of the man than on the work. A deep reflector which envelopes the lamp so that no portion of the bright filament is visible, should always be supplied. This will keep the light out of the eyes and will concentrate it upon the work, thus permitting the use of a smaller lamp and saving electrical energy.

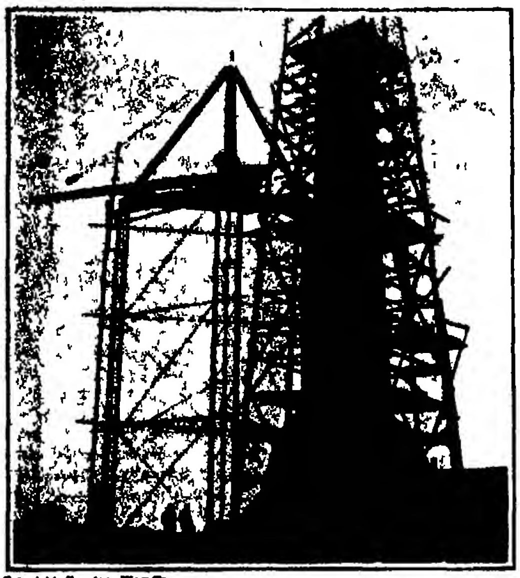
Photography in the Industries

THE possibilities of applying photography to industrial and business routine have only been touched. For it is certain that there is no better or more rapid manner of copying maps, plans, records, drawings, tracings, blue prints, valuable documents and other things than by means of the special cameras now available for just this class of work. Furthermore, the copies can be made to almost any scale, with relation to the original.

No plates, films or even a darkroom are required with the special copying cameras, in order to obtain a perfect photographic copy. All the objectionable features of ordinary photography are eliminated. Copies of any and all written, printed or drawn matter, whether contained in loose sheets or bound volumes, can be made in a moment's time. Direct, durable permanent copies from any sized original, can be made actual size, enlarged or reduced as desired.

The Built-In Electric Motor

LITTLE by little the electric drive has been developed into the built-in motor idea. That is to say, the electric motor, instead of being placed on the ceiling, floor or wall and connected with the machine by means of a belt, is now built right into the lathe, disk grinder, jointer, tenoner or other machine. Thus the machine becomes virtually a self-contained unit, with all the advantages that such construction implies. Furthermore, there can be no danger of using the wrong motor, since the motor is built right into the machine at the factory.



Copyright, Keystone View Co.
The Dover Patrol Memorial in course of construction, which has called for 700 tons of granite

The Dover Patrol Memorial

THE Dover Patrol Memorial has recently been completed. It is in the form of an obelisk, as may be noted in the accompanying photograph which shows this monument in course of construction. The obelisk is 84 feet high, the base is 21 feet on each side of the square, and the stone shaft gradually tapers off to about 5 feet at the top. Seven hundred tons of Norwegian granite have been used in the construction of the memorial.

Dog's Acre Beautiful

THE train stops for a moment to let off a few passengers at Hartsdale and hurries on. One party evidently in deep trouble and carrying a somewhat heavy box, enter a waiting automobile and are whisked away up the hill. If we follow them we soon reach a 5-acre cemetery on a delightful slope of one of the Westchester Hills just north of New York City. We might expect to see the hearse and all the panoply of woe, but they are lacking, although real sorrow is there for we have reached a burial ground for deceased pets, otherwise a "canine cemetery."

The dog shares equally with the horse in man's friendship, and man's intimacy with the dog is apt to be much greater. Now, when a dog is sick he is taken to a hospital where an expert veterinarian attends him without cost to the master and if he finally succumbs he can rest for all eternity in a permanent resting place with others of his kind. Previous to 1896 the disposition of deceased pets was a disturbing problem to the one-time owners. If they lived in the country they might bury "old dog Tray" in the garden, but if they sold the property the tiny grave over which the children had shed many a bitter tear, was lost.

Entering the gates we find a cemetery not looking very different from those where human beings are interred, except that the plots seem a little smaller and the tombstones are of modest dimensions. Here anyone can buy a few square feet, the minimum-sized lot costing $15. A moderate charge for "opening the grave," etc., is made so that the expense is not prohibitive, and even shop girls and coal drivers have been known to buy small plots for their beloved pets. Of course, those who wish larger spaces can be accommodated, and very large and choice plots can be had as high as $2500. The cemetery is open to animals of every description, so here we find canary birds, cats, horses, and even a pet lion once owned by Princess Lwoff Parlaghy. Cement dog coffins are inexpensive, and are made on the premises, but metallic zinc caskets are provided for those who wish to spare no expense for the last rites for their pets. Some of the tombstones show what a grip dumb animals have on their owners. Here are a few epitaphs: "Mignon, dearest and best friend." "Willie one of my dearly beloved pets", "Bessie, ever faithful and true, loved by all." "Our dear little comforters 'Jou Jou' and Daisy," and so on. Some of the more aristocratic inhabitants of these silent acres are interred in pretentious mausoleums costing as high as $12,000. This cemetery is now 24 years old and there are upward of 3000 interments. On Sundays there are often 500 visitors, and 37 automobiles have been counted outside the gate at one time. These figures are significant as showing what an appeal domestic pets, especially the dog, have for us and this feeling knows no boundary or language. Similar cemeteries are found in England and France, and as we gathered our facts, in came a request for information from Japan. There is no East or West for the dog.

Wearing the Scales for Good Measure

THE lemon picker shown in the accompanying illustration believes in efficiency. At least in determining his daily wage he must keep track of how many pounds of lemons he has picked, and this calls for constant weighing operations. To this end this ingenious picker has made a simple shoulder strap arrangement to which he attaches a spring balance. It is but the work of a moment to fasten a pair of wire hooks to the fruit boxes and get the weight.

A lemon picker who carries his weighing outfit with him, strapped from his shoulders

An expensive mausoleum for a dog, which is typical of the more elaborate graves in the Hartsdale Canine Cemetery

A Milk-by-the-Can Plan

IN high cost of distribution milk is everywhere a leader, and the margin between production cost and retail price is so wide in many cities and large towns that it is not such a very difficult matter for the nearby producer to sell direct to large consumers at a substantial price reduction, yet make an excellent additional profit himself. Large-quantity customers are necessary. With them delivery and collection labor is a low minimum. Without them serving many small users, the producer becomes essentially a retailer subject to the expenses which make distribution cost ordinarily so high.

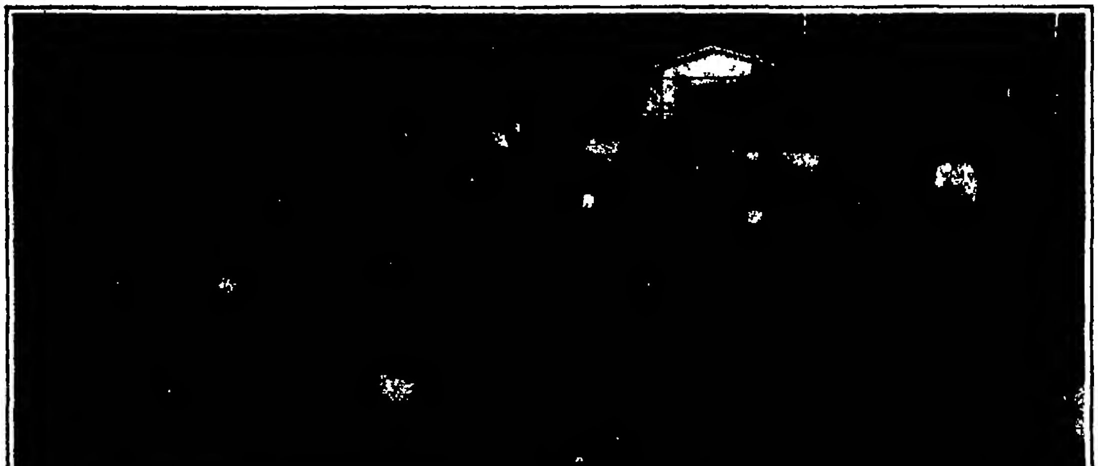
In a Boston suburb a unique business in milk direct from farm to consumer on a quantity basis is done successfully by a Townsend Harbor farm. This farm has some forty customers, each of whom takes an 8½ quart can every other day. The customers are restricted to a territory easily served. Delivering by auto a high school boy covers the entire route in about an hour.

And the price charged for milk is 12 cents—several cents below the regular Boston price. In fact the dairyman doing this business figures that he saves his customers $24 a day.

In securing customers, this farm distributed a circular in which it explained that the principal reason for the high retail milk price was the service the customer demanded of the retailer. "You can be your own milkman," he declared. "We will deliver an 8½ quart can of milk that will keep sweet for several days. It is from a tuberculin tested herd, safe and pure. It is rich in butter fat. We supply milk bottles. You empty the big can into bottles, slip on the caps and set them on ice. Two days later or four times a week, we call for the empty can and leave a full one. You get this splendid milk for $1 a can.

"You can share it with the lady upstairs or next door if you cannot use four quarts a day. You pay once a month. We reserve the right to refuse your order—we only have one private herd—or put you on the waiting list, and also to refuse an order on the basis of territory. We cannot afford to go too far to fill an order."

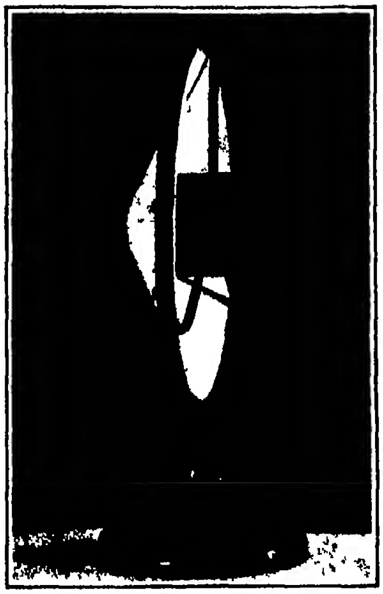
This plan, handled by the originator, works well. There is good business sense in it, and it ought to succeed quickly in many places, during these days when nearly everybody is looking for practical ways to cut down expenses. It is good because in eliminating service it puts nothing on the consumer which the average housewife can't readily attend to. Emptying milk from a large can to bottles is a little thing in itself, but it is the collective performance of such "little things" that adds much to the retail price.



General view of a corner of the Hartsdale Canine Cemetery, which is located on the slope of one of the beautiful Westchester hills, just north of New York City

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



Loud-speaking telephone that makes use of a cone-shaped parchment diaphragm

Something New in Loud-Speaking Telephones

THE above illustration represents an attempt to get away from the usual principles of loud speaking telephony The inventor in this case has aimed at a purity of sound that is not obtainable with devices that make use of metallic diaphragms operating in confined quarters and subject to all kinds of parasitic sound waves and impedances due to air compression

The present device it will be noted, makes use of a large parchment cone which acts as the diaphragm and horn combined At the apex of the cone is an armature, which is actuated by a pair of electromagnets contained in the casing mounted on three arms and centered in the parchment cone As the current fluctuates in the electromagnets the diaphragm or parchment cone is accordingly vibrated, reproducing certain sound waves. Because of the absence of a definite pitch in the parchment cone the sounds produced by it are not subject to the distortion that occurs with metallic diaphragms which have a fundamental pitch of their own The present device is suitable for the reproduction of phonographic music, in conjunction with a special microphone attachment, for addressing a large gathering, for radio reception purposes, and for all kinds of work calling for a loud speaking telephone

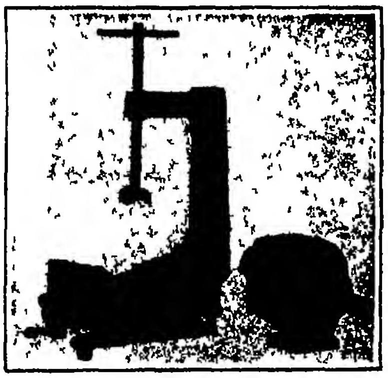
New milking stool which may be carried by putting one's arm through its seat

An Automatic Kitchen-Hand

THE latest attempt to help out the hard pressed housewife takes the form of a universal electric motor and stand which can be made to serve for a large variety of duties. Thus the motor and stand may be applied to the arduous task of grinding the ice cream freezer or beating a mess of eggs or stirring a large batter of dough for bread or cake It may be applied to driving the meat chopper or polishing the silverware A small grinding wheel driven by the motor serves to sharpen the various household knives, scissors, tools, and even the blades of the lawn mower

A New Test Vise for Electric Service Work

A NEW test vise for use in testing generators, starters and ignition systems has been recently developed by a Chicago manufacturer The deep recess in the bed plate of the vise automatically centers a round instrument under the take-up screw, while a square or irregular shaped instrument is held on top and against the side of one of the flat steps and is then held down securely on the bed plate by the threaded screw in the gooseneck Adjustment of the driving belt or chain is secured through a 6-inch movement of the bed plate, operated by the ball crank handle on the front.



Special vise for holding a motor or generator in position while it is tested

The Milking Stool Brought Up to Date

THE last word in a milking stool is a *stable* product. Sounds like a pun? Yet anyone who has ever milked twenty bovines and tried sitting upon a little flat, square board, supported precariously by one wooden peg under the middle will recall how *unstable* a pedestal it was. Modern sanitary science asks for a clean stable, a clean cow, and cleanliness in the person, clothing and equipment used by the milker in order that germ-free milk from the producer, Madam Cow, may not be contaminated before it reaches the ultimate consumer

Should the new stool become soiled it can be washed, even boiled, for it is made of aluminum strengthened by an alloy It weighs but two pounds and can be shipped in a compact parcel and assembled by bolts. The concave seat, which is merely a wide rim with a hollow center, is comfortable to use and convenient to carry upon the arm leaving the hands free to carry the foaming milk pails

A Grinder Used for Snagging Castings

FOR snagging castings it is essential that a grinding device combine large amounts of power with light weight. This grinder, just introduced by a Massachusetts manufacturer, consists of a shaft with a handle on each end. Inside of the shaft is a switch and a wheel with its mountings rotates on the shaft. The mountings for the wheel are used as the motor, which is of the squirrel cage type, but reversed so that the secondary member of the squirrel cage construction rotates around the winding instead of inside This rotating member consists of a thin shell of malleable iron carrying the bars of copper The wheel flanges and end plates are of steel so as to carry the magnetism The current flows through the copper bars across the copper lined end plates to the copper bars opposite In this way every part of the rotating member is used to carry current, magnetism, or both, except the wheel itself. The very nature of the electric motor and the principles on which it works leave room for much ingenuity on the part of the designer, the present model takes full advantage of the possibilities.

This motor-driven stand can be applied to all kitchen tasks, from making ice cream to polishing silver

This grinding device virtually contains the driving motor inside the grinding wheel

Doing Away with Rewinding in Motion Picture Projection

AFTER a film has been run through the usual motion picture projector, it is obviously necessary to rewind the film on to another reel in order to restore to its original form. This process is expensive, time-consuming and helps to wear out the film. From time to time ingenious mechanisms have been introduced with a view to eliminating rewinding, and we have the interesting apparatus shown in the accompanying illustration to add to those that have gone before.

The present mechanism takes the place of the lower magazine of a motion picture projector. The basic principle of this invention is a rotary contracting drum which winds the film from the outside and finishes in the center by means of ten fingers which travel with the drum and hold the film outward. As the film builds up the fingers yield inwardly and at the point where the film enters, these fingers are lifted and lowered again by positive cam action.

The schoolboy's trick of winding his strap into a compact reel, by inserting the plain end through the buckle and running it round and round the inside of the loop thus formed, is not too different in principle from the new device to suggest that boyhood experience may have furnished the necessary inspiration to the inventor

The inventor of this device claims that the creepage usually taking place when the film is wound upon the lower reel of a standard projector is overcome in this device The creepage has a tendency to scratch the delicate emulsion of the film, during projection and during rewinding.

With this new device the film is taken from the motion picture projector and inserted about two inches into the reversing reel. No fastening whatever is required, as the fingers hold the film down, thus keeping the film from creeping. The film is not wound in a round form but is pulled from point to point, inside the fingers, thus winding the film in the form of a decagon The film also runs over an automatic governor which keeps the film at a very light tension, this tension being maintained constant from start to finish. Each machine is equipped with special core reels. One-half of a reel is placed in the machine before winding and when ready to remove the other half is snapped on and the film is then pulled out, ready for immediate showing. Rethreading, in case of a break in the film, is said to be greatly simplified.

[illegible]

Pennsylvania's Roads

(Continued from page 144)

into the buckets of the concrete mixers.

Another result of this in addition to the marked improvement of the finished road and the reduction in cracks is that it speeds up construction Records from which might be struck an average of day runs are not yet available, but under the present system engineers say there has been a decided increase in this average. On one typical job—that on the West Chester Pike previously referred to—a gang of forty men has been averaging 865 feet of new road every day of twelve hours. The minimum day run has been about 800 feet, the maximum 506. Five trucks operate with this gang One section of two and a quarter miles for which the contract allowed one hundred days was finished in thirty three days.

With the dumping of materials direct from trucks to the mixing machine a second handling is eliminated The curing process in Pennsylvania follows the general modern highway engineering practice in other states Roads are leveled with a template and the morning after completion the day's run is covered with gravel and rock. This is sprinkled daily for eight days to permit the concrete to dry uniformly The covering is left on for twenty-one days, by which time the road is ready for use

Engineers at work on the system say that cracks in the concrete are running from three to six a half mile, but in nearly every case, under the new specifications in effect this year, the fissures are slight and appear only in the two-inch surfacing above the wire reinforcement These are filled at once with the asphalt mixture used in making the expansion joints and so far cracks so treated have not shown any appreciable widening. Last year the concrete road cost in Pennsylvania went up to $60,000 a mile, an increase of nearly $25,000 over pre-war figures The total cost for the mileage under construction this year is not expected to exceed $50,000 and on some sections is considerably lower

On grades of eight per cent and lesser grades running on sharp curves the Department is laying a paving of hillside brick, cut to afford a grip to the caulks of horses, on a base of six inches of concrete. The brick used is made of shale, with a wire cut lug, and is grouted in with cement On this type of road the mixture for the concrete base is one part cement, three parts sand and six parts stone For the plain and reinforced concrete roads the mixture is one part cement, two parts sand and three parts stone

A Problem and Its Attempted Solution

(Continued from page 146)

the new design It contains copies placed in the compartments about four months before the photograph was taken, it was in no way "dressed up" for the purpose of taking the view A comparison between this picture and Fig 1 is a complete demonstration of the difference between the customary and the newly worked out means of storing copies. The patents in both cases show the results of four months' pulling from groups which at the beginning of the period were in perfect alinement and proper sequence

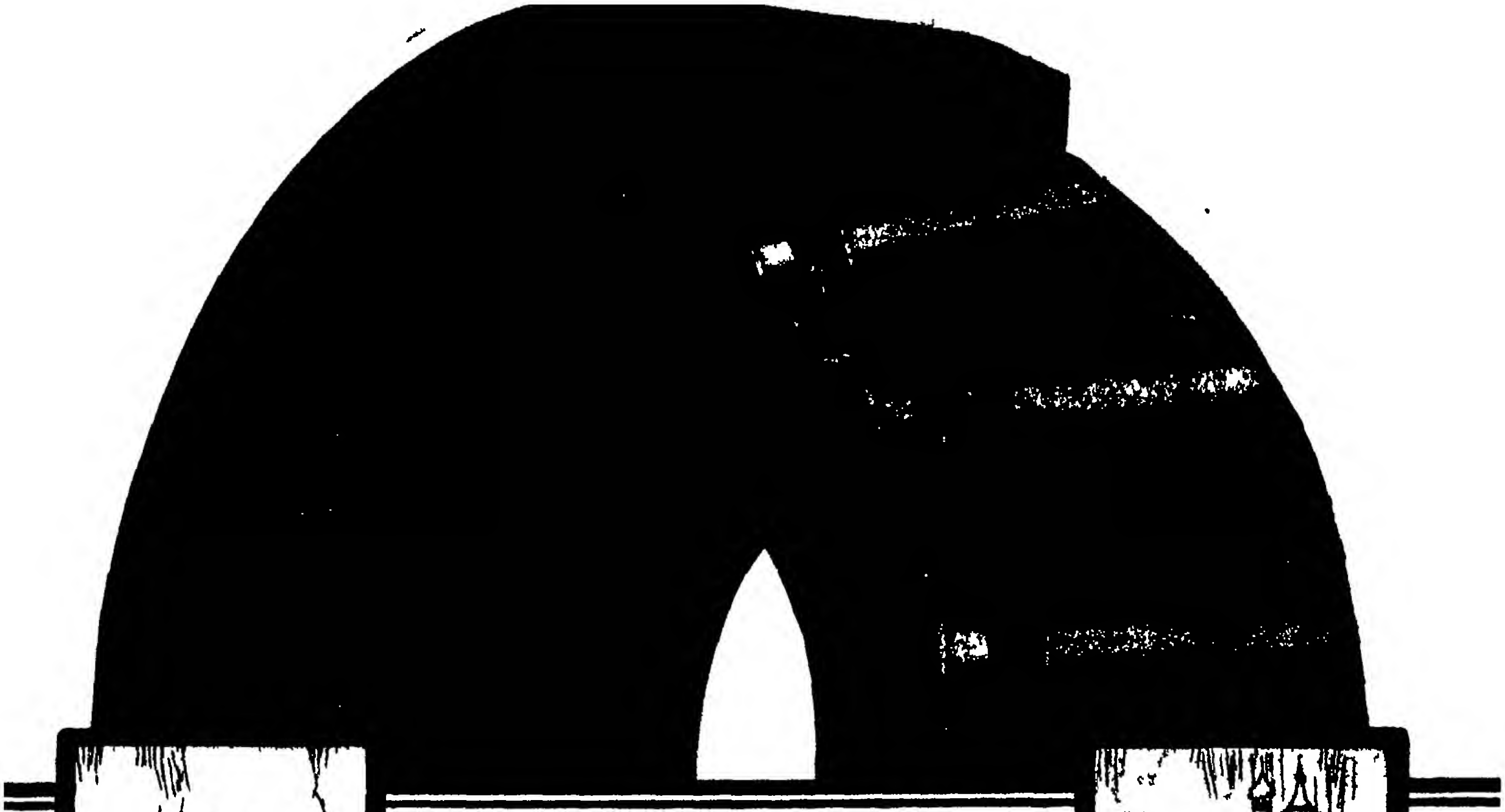
The case illustrated in Figs. 2 and 3, while demonstrated practicable and vastly superior to the old way beyond any possibility of doubt, is a long way from being standardized as the regular Patent Office procedure This case is not of cheap construction, on its face it costs considerably more than open bins of equal capacity Extensive installation of this style of equipment cannot proceed without special provision for it in the regular appropriation or in a special bill The Patent Office, since the demonstration of the advantages of the new-style case, has managed to provide enough cash out of its extremely circumscribed funds to install eight of the units shown in Fig 2 These eight units will hold eight weekly issues of patents Perhaps the implication that the Patent Office every week issues enough patents to insure that a stock of the copies *will* fill a case of these proportions will be illuminating to some who had not realized the scale upon which Patent Office operations are carried out

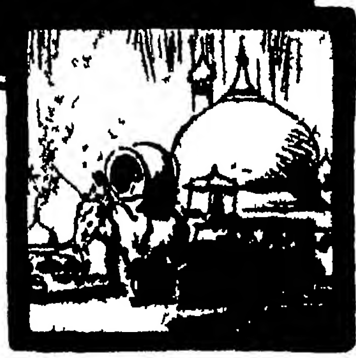
The ideal, of course, would be the provision of sufficient money to enable the Patent Office to store its entire stock of copies, within a reasonable time, in filing cases of this character This ideal it is hoped will be approached when the efficacy of the new equipment will be demonstrated beyond question With the appropriations that are available for the present fiscal year beginning July 1, 1921 an installation for almost a year's use may be instituted Whether appropriations can be obtained for the 1,400,000 bundles of patents already granted to take them out of the old, inadequate, in sufficient and expensive conditions in which they are now stored is a matter for hope and future determination

The point, however, is obvious. Copies and copy pulling has always been the skeleton in the Patent-Office closet, for the very excellent reason that no method of storage has ever before been known which would make the storage and the pulling clean and precise Now such a method is known, and at the disposal of the Patent Office It has been demonstrated on a scale small enough to be sure, yet large enough to give foundation for the estimate that if the entire installation of patent files were of this latest type, a reduction of force of 30 per cent in the copy pulling branch of the Patent Office could be made with a reduction of inaccuracy of 90 per cent. It is difficult to exaggerate the loss to commercial interest by the report that a certain patent is out" when it is merely out of place, and the loss to the Government through the reprinting of patents that are thus erroneously reported to be exhausted Along with these gains, there would automatically come a material reduction in the extent of executive supervision of copy storage and copy pulling, an appreciable increase in revenue from the sale of copies, and an immeasurable improvement both in the quality and the speed of the service to the public Finally, if the framing were of steel instead of wood there would be attained a favorable condition not now existing in the miles of inflammable shelving spread through the corridors and galleries of the Patent Office But of course the immediate problem is to obtain equipment that will permit service, collateral advantages are of merely collateral importance The way has been shown how to dispose of this vexing Patent Office problem for all time, it is to be hoped that Congress can be made to see the wisdom of making it possible for the Patent Office to put into effect the solution thus offered

The Largest Crater in the World

TWO Swedish scientists named Waddell and Ygberg recently made a journey of exploration through Iceland with the interesting result that they discovered the largest volcanic crater in the world. It took them nine days, using three horses and sledges to cross the great sea of ice of the Watnajokel from west to east in order to reach Kolar on the Fjord of Hornar Upon the Högjökel they found a tremendous volcanic crater containing hot water and no less than 8 kilometers long and 5 kilometers wide. It was surrounded by a number of hot springs. The Swedish savants who discovered it named it the Svea crater, and it is regarded as not only the greatest crater in Iceland but probably, so far as is known at present, the largest in the world





અમેરીકામાજ નહી પણ
દુનયાના સર્વ ભાગોમા જયા
અમેરીકન અને વેલાએતી
મોતોકારો અને મોતોરટ્રકો
તથા ટ્રેકટરો વપ્રાએ છે
ત્યા તીમકન.તેપરડ રોલરબેરીગ્સ
થી ઘણો ફાયદો થાય છે.

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THE MOTOR CLIPPER

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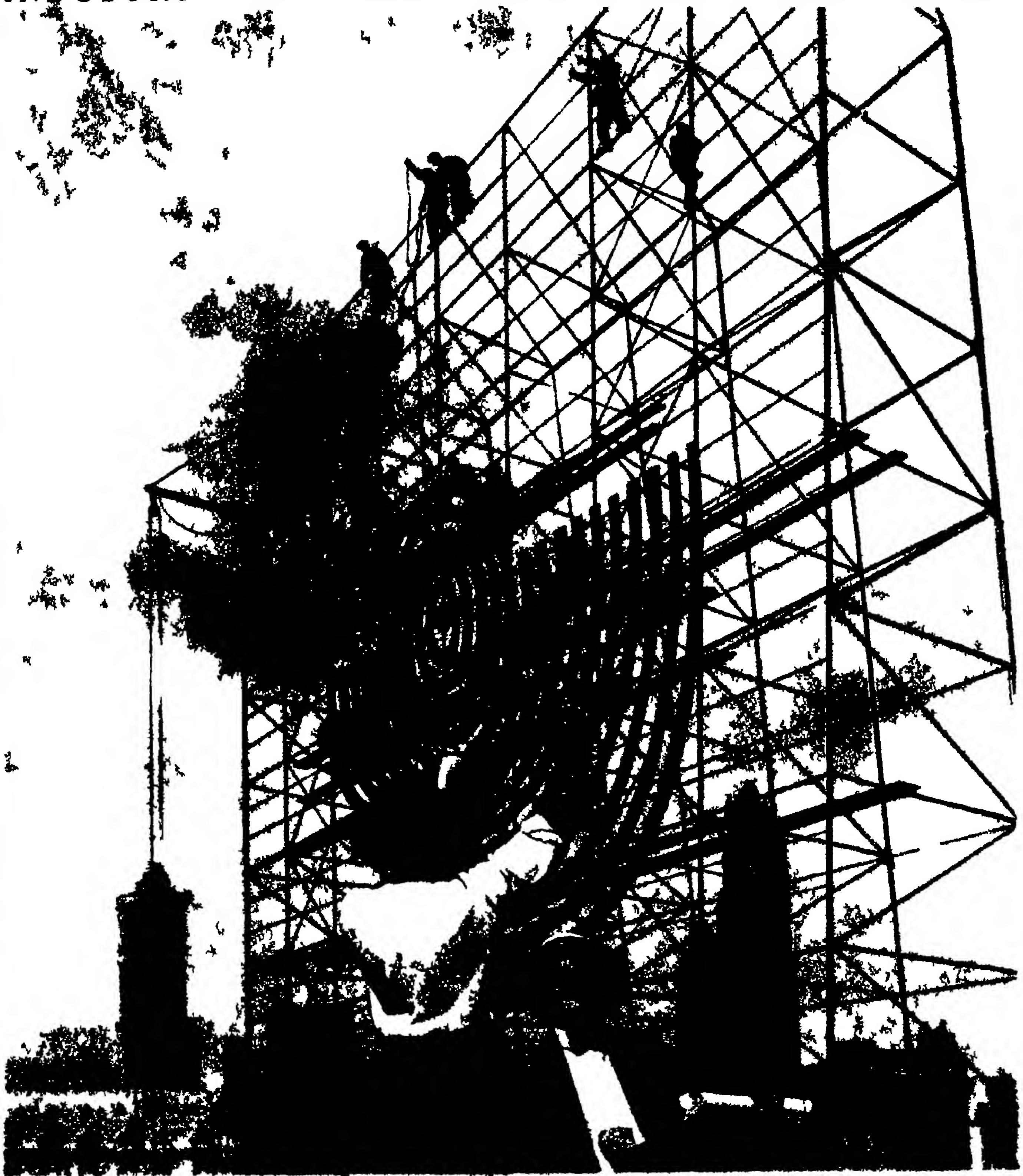

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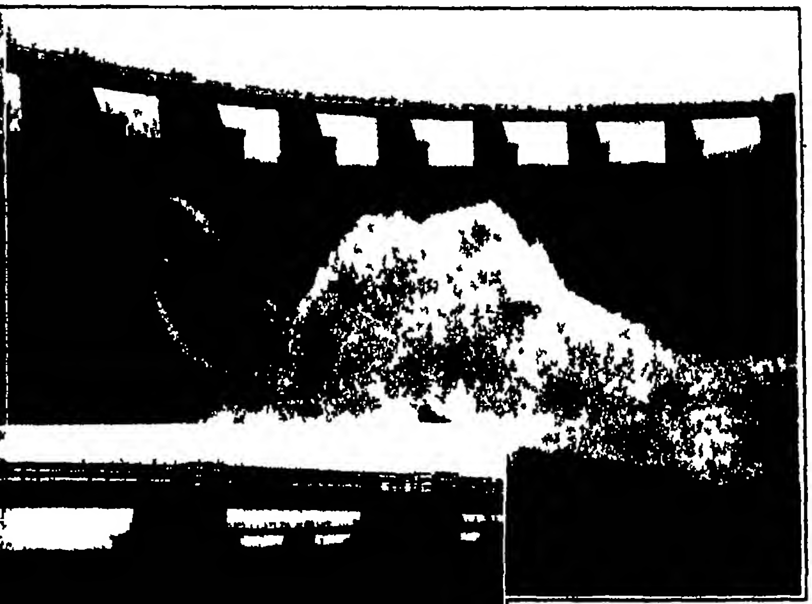

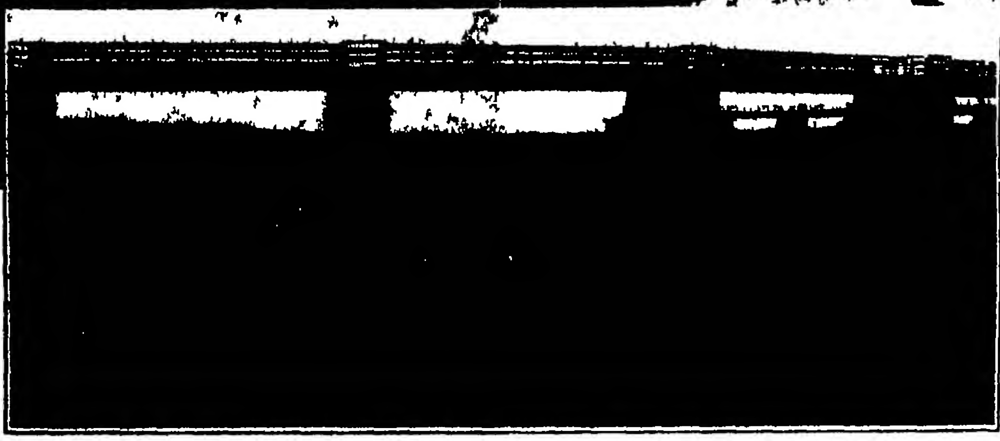

1 The rise of water in the green jungle upon completion of the dam was one of the most tragically beautiful sights of nature ever witnessed The dying jungle is seen in this view when the surface of water was 7½ feet above mean sea level 2 When there is a surplus of water during the wet season it is wasted over the spillways in the Gatun Dam 3 Looking towards the Atlantic from the spillway with the hydroelectric plant in the foreground and the Chagres River 85 feet below

Some features of the water supply for the Panama Canal

Water Supply of the Panama Canal

By Crede Haskins Calhoun

THERE was no little discussion of the water supply for operating the Panama Canal when the question of the sea level or lock type of water way was being considered Engineers favoring the sea level canal were of the opinion that there would not be sufficient water to operate the lock type the greater part of which was to be 85 feet above sea level After consultation with some of the most eminent engineers in the world President Roosevelt took the responsibility for deciding in favor of a minority report recommending the lock type

The water for lockages and floating vessels at the 85 foot level from Pedro Miguel to Gatun a distance of 28.52 nautical miles in the present canal was obtained by building a dam across the Chagres River at Gatun and then blocking the Gaillard Cut (formerly Culebra) by the locks at Pedro Miguel This has created an artificial lake with an average area of 165 square miles, extending from Gamboa to Gatun and reaching with its octopus-like arms far inland through the jungles Only a portion of this lake area in the vicinity of Gatun locks was cleared before flooding and in the rest of the area the jungle was literally drowned The gradual rise of this water in the green jungle upon completion of the dam was one of the most tragically beautiful sights of nature ever witnessed, though behind it all was the hand of man Now the lake presents a spectacle of sun bleached skeletons of trees, once as gloriously beautiful as only trees, and tropical trees, can be, bearing occasional bunches of orchids like funeral offerings of nature

Experience has shown that so far there has been sufficient water for operating the canal though during the last dry season the lake was at the lowest level in history, due to the number of lockages and the fact that it was one of the longest dry seasons in a good many years The dry season in Panama usually lasts about four months and during the rest of the year the almost constant rains tend to keep the lake at a high level and furnish more water than is needed The rainfall at the canal averages 129 inches a year at Colon and 69 at Panama while the average is probably considerably higher at the headwaters of the Chagres River

As a result of the low level last dry season in preparation for the present season which began in mid December 1920 the operation of the spillway of Gatun Lake (the spillway is a series of gates in the dam that lets out surplus water) was regulated in the early part of December to bring the surface of the water to the maximum storage height 87 feet above mean sea level This point was reached on December 7th and was maintained until December 23rd, when a dry period lowered the water to 86.90 feet A rain on the 28th brought it up again to 87 but since that time it has dropped about half a foot below that point The level of the lake cannot be raised above 87 feet because above that point the withdrawal of water from Gaillard Cut for a lockage would create a surge a miniature tidal wave that would flood the operating machinery of the Pedro Miguel locks

The area of Gatun Lake at its normal elevation of 85 feet above sea level, which is 2 feet below the storage maximum is 163.4 square miles A foot of water spread over that area runs into billions of cubic feet and to use a slang expression is some water Of course with a rise in the level the water rises on the banks of the lake and also increases the area At 86 feet above sea level the area of the water surface is increased by 2 square miles and at 87 feet by more than 4 square miles over the area at the 85 foot level

The quantity of water necessary to raise the surface of the lake from the 85 to the 86-foot level is 460 billion cubic feet (you have to stop and say that number over to yourself to appreciate it) and the quantity required to raise it from the 86 to the 87 foot level is 465 billion cubic feet So it can be seen that the raise of two feet in the level of the lake provides a storage of almost ten billion cubic feet of water

Of course the lake loses much water through evaporation during the dry season as the tropic sun is very hot and that is about equal to the run off from the watershed of the lake as the result of occasional rains during the dry season The total loss through evaporation during the calendar year 1920 was 2.40 billion cubic feet representing about 13 per cent of the inflow The principal source of supply for the lake is the Chagres River a long and during the wet or rainy season mighty river fed by many tributaries that collect water from the mountain valleys over an area of hundreds of square miles The rainy season lasts eight months and people who have not seen a tropical rain have only experienced gentle showers by comparison During this time there is a surplus of water in the lake which is wasted over the spillways This amounted to 87 billion cubic feet or 47 per cent of the inflow during the calendar year 1920

Only 10 per cent of the water used from the lake during the calendar year 1920 was on account of lockages in lifting vessels to and lowering them from the 85-foot level of the main part of the canal It is esti

(Continued on page 171)

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The Loss of "ZR-2"

NO element of tragedy is wanting to render the loss of the "ZR 2" one of the most lamentable disasters in naval and military history This huge ship the *largest and fastest* of its kind, was approaching its landing place after a most successful and extended flight, lasting for a day and a half, when, without warning she broke in two, burst into flames, and with terrific explosions fell into the River Humber This meant the failure and complete loss of a dirigible which was believed to embody the ripest experience of the masters of aeronautical design, and which had been built at a cost probably exceeding two million dollars That in itself was bad enough, but a far greater tragedy is the fact that in this disaster there died the very flower of the dirigible experts of the United States and Great Britain The death roll includes the names of Brigadier General E M Maitland, Chief of the Royal British Air Force, and of Commander Louis H Maxfield, the ablest officer in the lighter than air forces of the United States Navy In addition to these is a pitifully long list of United States and British officers, all of them expert in their special fields, and a large force of non-commissioned officers and enlisted men At the present writing the exact number of fatalities is not known, but since not over half a dozen seem to have escaped death, it is possible that the final list will include over forty officers and men

The "ZR 2" left the Howden base at 7 10 A. M on August 23rd for an extended trial trip which was to be completed by a run at full power at a speed of 75 miles an hour This was her fourth flight At 8 P M she *signaled that she would stay out all night*, and another message was received at 7 A M on August 24th that she would continue to cruise throughout the day At 4 30 on the evening of the 24th she sent word that she was about to carry out her full speed trials, and her last message came in at 5 34, when she stated that she would make a landing at Howden at 6 30

At 6 30 P M, when the great ship was passing at a moderate elevation over the city of Hull she was seen gradually to buckle at the center and then break in two This was followed by fire and a series of explosions, which were sufficiently powerful to break the windows in the city below Fortunately for the inhabitants the commander of the ship is reported to have swung her out toward the harbor and she fell in the river not far from the Hull docks

A strong presumption as to the cause of the disaster is afforded by the preliminary trials of the ship, in which she seemed to develop a lack of sufficient girder strength, certain parts of her frame showing signs of buckling An attempt was made to remedy this by the introduction of additional stiffening material In the absence of any exact data it is impossible to make any definite statement as to the cause of her loss, but it certainly does look as though, in the effort to secure great cruising radius and the abnormally high maximum speed of 75 miles an hour, the framing of "ZR 2" had been cut down perilously close to the margin of safety, whatever that may have been

A suggestion as to the immediate cause of the disaster is found in the testimony of witnesses that just before it occurred, she made a rapid change of course This would throw a heavy pressure on the rudders which in turn, because of the inertia of the concentrated weights, would bring a heavy bending moment to bear upon the fragile structure of the whole A sudden local puff of wind inopportunely striking the rudders at this moment, would increase the effect, and the combined result may have been too much for the girder strength of the ship

Uncharted Perils of the Road

VARIOUS sections of the country have experienced, during the recent intense July heat, a phenomenon usually referred to as the "blowing out of the road This occurs only on hard surfaced highways, and is usually confined to those of concrete, brick or blocks The cause of course, is found in insufficient allowance for expansion in laying the pavement. Most of us have passed places where the road was thus upheaved, or have even encountered a road made almost impassable by such occurrence But a new angle is given by a Connecticut paper that tells how the road "blew up" under a passing car, and actually hurled the occupants a considerable distance The idea of having the road explode beneath one is startling, to say the least.

An exploding road is not the only thing that may embarrass the midsummer tourist and lead him into a detour, however The morning papers recently told a curious tale under a Kentucky date line A hollow tree along the roadside near Lexington had been inhabited for many years by a large colony of bees. A big storm blew it down across the road, and scattered honey all over the neighborhood The bees refused to abandon their property, and hovered in great numbers over the scene of the tragedy Everyone who attempted to approach the spot was speedily put to rout by the angry insects, who at last accounts still held the fort, while all traffic was being detoured

At the time when this curious item came to our attention we had just had an illuminating experience of our own Everybody knows that a freshly oiled road is slippery and skiddy Does everybody know that, given enough oil, it becomes absolutely impassable? On a certain 200-yard section of winding, sharply-crowned road the enterprising foreman laid enough oil for about two miles of roadway The result was a blockade that lasted all the afternoon, and several *very close shaves that failed of being wrecks only by a miracle.* The road surface was so slippery that it was literally impossible to walk on it, let alone drive a car We know this, because we tried it, and skidded expeditiously into the ditch.

Some weeks ago we made still another surprising discovery, which still has us chuckling In tracing the route from town to town and from fork to fork between two termini, as given by the road book, we encountered the following charming entry "18.5 miles Caution for deep ford. Cross well up at a slight angle, go around the big snag to the left, and then sharply to the right just before reaching the far bank." And again, a few miles farther on "Caution for *very* deep ford Best crossing is found by going upstream to the footlog, and crossing directly below this" This we must confess is one of the perils of motoring that had not been brought to our attention by our experience *in the effete east When one makes a misstep in one* of these deep fords and goes in above the level of carbureter or distributer, we wonder what the next move is? Does one of the party go swimming after a farmer with a horse, or is the first passing motorist supposed to do the rescue act?

There is something else that, sooner or later, happens to every driver of a car with gravity fuel feed The manufacturers of these cars tell you never to let the fuel get very low They do not tell why, and most purchasers, being better posted than the short-story writer who represented a green driver as being able to stop without serious difficulty *because the gas was low*, are inclined to laugh at the warning If one of these cars ever goes dead under you while running up a hill you may be in a position to learn why five gallons of gas in the tank are better than a gallon and a half Under such circumstances, before fussing with the ignition *system or worrying about the condition of feed* line or carbureter, permit the chariot to roll down to the first level spot, and see whether the trouble was not due to low gas. The possibility of getting on a hill where the carbureter intake enjoys a greater elevation above sea level than the surface of the fluid in the tank will be better realized when it is stated that, so far as power alone is concerned, the "well-known American small car" will run up a hill so steep that the tank must contain more than six gallons of gas in order to get any flow to the carbureter.

When the gas station is at the bottom of the hill, of course, one simply slides down to it. When it is at the top the remedy is equally simple though perhaps not so obvious. Turn the car around, by man-power if necessary, and back up the hill to the pump.

The Backbone of the Fleet

THE report rendered by the Joint Army and Navy Board on the recent aerial bombing tests off the Virginia Capes confirms the lessons which we drew in our issue of August 6th from these trials. The findings of the report are summed up in the following statement "The battleship is still the backbone of the fleet and the bulwark of the nation's sea defense, and will so remain so long as the safe navigation of the seas for purposes of trade or transportation is vital to success in war"

The above quotation *is one of the ten conclusions*, categorically stated, in which the Joint Board, made up of naval and army officers, submitted its findings on the burning issue as to whether bombing aircraft have rendered the battleship obsolete The argument runs as follows That if the Navy commands the sea routes, the lines of traffic can be kept open without entering the area on the enemy's coast zone which is controlled by aircraft bases on shore Conversely, a nation without an effective navy must submit to a fatal economic blockade Again, if heavier-than air craft are to be effective in naval warfare, they must be able to operate in midocean, and since their own radius of action is limited, they must operate from those *mobile bases known as aircraft carriers.* Although our Navy does not know of any case in which bombing planes, such as sank the "Ostfriesland," have flown from or landed on an aircraft carrier, it is believed that such operations will in the future become practicable In this connection, the report quotes the "Argus," of the British Navy, as a type essential to the highest efficiency of the fleet, but the point is made that since aircraft carriers are subject to attack by vessels armed with guns, torpedoes or bombs, they, like all other subsidiary types of vessels, will require the eventual support of the battleship

We think this last statement is subject to criticism A 30,000-ton, 32 knot aircraft carrier would be self supporting, and for defense against a too-powerful enemy would depend upon her superior speed to enable her to keep out of range The best of modern battleships cannot hit beyond 20 or 25 miles—an aircraft *carrier could maintain a range of 30 miles and* send out her bombing planes against the enemy with complete immunity to herself

The report admits that although the airplane, like the submarine, destroyer, and mine has added to the dangers to which battleships are exposed, it has not made the battleship obsolete, although the appearance of aircraft has added to the existing complexity of naval warfare

With the final clause of the report, as indeed with the whole report as such, we are in thorough accord It states that the aviation and ordnance experiments, conducted with the ex-German vessels as targets, have proved that it has become imperative as a matter of national defense to provide for the maximum possible development of aviation both in the Army and Navy These bombing experiments have also proved the necessity for aircraft carriers of maximum size *and speed as an effective adjunct of the fleet. It is* likewise essential that effective anti-aircraft armament be developed.

Now there is danger, we think, of becoming so greatly impressed with the necessity for building an effective fleet of aerial bombing planes as to overlook the equally important defensive side of the problem The present popgun arrangements, mounted on warships for the purpose of bringing down airplanes are futile Shells thrown by 3- and 4-inch gun do not afford a big enough burst and spread, moreover, there remains to be developed an accurate and swift means for determining the ever-changing position of the enemy We look to see the day when the 5-inch anti-torpedo batteries of warships will be known as anti-torpedo and anti-plane batteries, which means that they will be mounted on the topmost decks and provided with unlimited elevation.

Electricity

Hydro-Electric Developments, totalling 13,500,000 horsepower, and a doubling of the present ratings of central station plants, are regarded as probable within the next four years by some American authorities. It goes without saying that vast quantities of copper are to be used, for until now there is not a real substitute for this metal. Aluminum is an excellent alternative, but copper remains the best conductor material.

Radio Service Between London and Paris.—From the French journal *Radioelectricité*, we learn that stations for regular communication between these two cities are located in Neuilly Levallois, France, and Chelmsford, England. A high-frequency generator of 10 to 25 kilowatts is employed for sending. Signals are first recorded by perforation by means of a special machine upon a strip of paper and are then sent at about a hundred words per minute. The received messages are considerably amplified and are registered upon a fast rotating wax disk similar to that of a phonograph. For transcribing, the disk is revolved much more slowly, to enable the operator to copy the message on a typewriter.

Radio Aboard Airplane.—In a recent issue of *Radioelectricité* there are described the various stages of the development of radio communication from and between airplanes. The first satisfactory operating set in French aviation contained a spark coil fed from a 20-volt storage battery. Later the heavy storage battery was superseded by a small air screw-driven generator running at an average speed of 4500 r.p.m., and delivering 20 volts at 5 amperes. Finally, two types of air-screw-driven 900-cycle alternators were developed, differing only in weight and bulk from each other. Both are rated at 50 volts and 7 amperes at 4500 r.p.m. The machines contain a direct-connected exciter and a tooth-wheeled generator with no rotating windings. A rotary spark gap mounted on the main generator shaft is used on both types.

Electric Cooking Simplified.—Everyone is ready to admit the superiority of the electric stove over all other types. It is clean, efficient, cool in summer, and certainly scientific. But it is expensive to run in most localities where current costs upwards of 10 cents per kilowatt hour, and therein lies its greatest drawback. Now an American manufacturer has come forward with a remarkably economical electrical range. It comprises an aluminum lined electric fireless cooker, fully equipped to steam, stew and broil foods. Needless to say, the minimum of current is required for this device. An aluminum-lined electric oven is also included, fully equipped to bake, roast, broil and toast perfectly with two 660-watt units. Then it also has a solid cast aluminum frying skillet, with self-contained nickel chromium heating element, which gives instant heat for frying.

The Department of Commerce has recently announced the appointment of R. A. Lundquist, of Minneapolis, Minn., as head of the newly created Electrical Machinery Division in the Bureau of Foreign and Domestic Commerce. This is one of the new industrial divisions made possible by Congress through the export industries act. It is planned to secure the services of experts to specialize on the more important export commodities. Mr. Lundquist, who is a graduate of the University of Minnesota, is an electrical engineer of wide experience. He has made extensive studies of possibilities for the sale of American electrical goods and machinery in Australia, New Zealand, China, Japan, and South Africa, the results of which were published by the Bureau of Foreign and Domestic Commerce, and is the author of "Transmission Line Construction Methods and Cost," and various articles for technical and engineering journals.

Pacific Coast Inter-City Radio.—The Federal Telegraph Company, so we learn from *Electrical Review*, has about completed the construction and equipment of radio stations at San Francisco, Los Angeles, and San Diego, Cal., and at Hillsboro, Ore., for inter-city communication. The San Francisco and Hillsboro stations, which are identical as to design and capacity, have a transmitting range of 5000 to 7000 miles under favorable conditions, and the equipment is similar to that of the Lafayette station at Bordeaux, France. The tower at the Hillsboro station has a height of 626 feet and a horizontal cross-section of 6 by 6 feet. The columns comprising this tower are supported in vertical position by five sets of guy cables, having four guys to each set, with each guy anchored to a reinforced concrete pier. Four arc converters are employed in each station, one being of 60-kilowatt capacity, the other three being of 30-kilowatt capacity. The stations are equipped with quadruplex transmission, giving a speed on any one circuit of about 150 words per minute.

Science

No Tree Signs for the Navy.—The efforts of the National Highways Protective Society has resulted in orders from the Navy Department that the recruiting service at once cease to use growing trees as billboards for recruiting signs.

Accidents in the Alps.—The abnormal heat in Switzerland has given an impetus to mountain climbing, in consequence, an appalling number of accidents is reported. Climbers usually fall into ice crevasses or are struck by falling stones.

Sir Richard Burton.—In celebration of the hundredth birthday of this intrepid explorer, whose adventures read like his own translation of the Arabian Nights, the Royal Asiatic Society will institute an annual memorial lecture and strike a medal bearing Burton's effigy.

Archaeology on the March.—In their progress through Asia Minor, Greek troops discovered in an old cemetery near Kutaia columns of blue marble formerly part of a great building of the Roman period. Many inscribed tablets were also picked up on the march.

Explorers Disagree.—Stefansson says he will take along no food on his mush to the Pole, while his rival Amundsen has just contracted for a seven-years' supply. Amundsen says there is little animal life north of 85 degrees, and the sleds must be loaded with food if the explorer would not face starvation.

Eustachio's Manuscripts.—Bartolomeo Eustachio, whose name is perpetuated in the term "Eustachian tube," was an Italian physician to whom Pope Pius IV gave permission to dissect human bodies in the furtherance of anatomical knowledge. The original manuscripts of his works have just been unearthed.

Rotation of Venus.—Observations of certain dark spots on Venus by Prof. W. H. Pickering appear to indicate a rotation period of 68 hours. He states that the motion of the spots was not from west to east but from north to south, implying that the axis of the planet lies very nearly in the plane of its orbit.

Varro's Aviary.—Varro, author of a famous book on agriculture, lived in the Ciceronian age. He built a model aviary, with fish ponds, and duck houses enclosed by fine gut nettings. Similar netted spaces housed blackbirds, nightingales and other song birds. A little channel furnished fresh water, and food was introduced beneath the nets.

An International Hydrographic Bureau, with Great Britain, the Netherlands and Norway represented in the directorship, has been established. Headquarters will be at Monaco, where it will doubtless have the cooperation of that eminent oceanographer, the Prince of Monaco. The United States has announced its intention of becoming a member.

Field Work of the Smithsonian Institution.—In 1920 this institution undertook 23 separate expeditions in various branches of science. The work in the Canadian Rockies was eminently successful. New astrophysical stations were established in Arizona and in Chile, and from these may be definitely determined the value of the solar constant in weather forecasting. The African expedition yielded a wealth of zoological material, and from Australia came rare specimens of the fast-disappearing fauna. On Mt. Wilson, Cal. a device was used that by the sun's heat alone cooked bread, meat, vegetables and preserves.

Proposed Reform of Our Calendar.—Prof. René Baire, of Dijon, has a most revolutionary plan for calendar reform. He would shorten most of the weeks to six days, give us a Saturday but once a month, take one day from January and, except in leap year, from July, and give February thirty days. The 1st, 7th, 13th, 19th and 25th days of each month would be Sundays—sixty to the year, and New Year's day and Christmas would always fall on Sunday. This sidetracks the objections to placing certain days in each year outside the weekly and monthly reckoning. It is doubtful, however, if the public would ever cheerfully accept this reparceling of its time.

Confirmation of Pickering's Lunar Observations.—Prof. W. H. Pickering's numerous accounts of rapid changes on the moon's surface, attributed to snow, vapors, etc., have been received with a good deal of skepticism by astronomers in general. He has now acquired a champion, in the person of Sir W. H. M. Christie, who visited him at Mandeville, Jamaica, last February and made observations of the moon with the Draper 11 inch refractor. The British astronomer reports in *Monthly Notices* R.A.S. that, in spite of unfavorable weather, he observed remarkable changes in the craters Aristillus and Eratosthenes and also in the Bradley "Snow Field." The changes are fully described and illustrated with drawings.

Aeronautics

A Height Record.—From France comes word that Georges Kirsch created a new height record recently, when, on a "Nieuport," equipped with a 300-horsepower Hispano-Suiza engine, he reached an altitude of 9800 meters (32,153 feet), thus beating the previous record held by Casale of 31,216 feet.

Paris Aeronautical Exposition.—The Seventh International Aeronautical Exposition will be held at Paris on November 12 to 27, 1921, according to a recent communication. Exhibitors are welcome from any country not having been at war with France. This exposition is not confined to flying machines and motors, but will include sections devoted to aerial navigation companies, motor boats, gliders, machine tools, marine motors, electrical apparatus, spare parts and industrial materials relating to the aeronautic industry.

An Ambitious Project.—It is reported that there is in process of formation an all British aerial transport company, which proposes to run regular services of airplanes and airships—the former daily to Paris, Brussels, and Amsterdam, and the latter twice weekly to America and Canada. The airplanes will be built entirely of metal and so designed that in case of a forced landing in the sea they will float and the passengers will not get wet. Parachutes will be fitted to the aircraft. The airships are intended to do the journey to New York in 48 hours. They will carry 50 passengers and will contain sleeping cabins, dining and smoking rooms, and a lounge, while the catering will be in charge of a chef. The crew will number 15. The inclusive fare to New York will be about $250, which is approximately the present steamship first-class fare.

Improved Airplane Propeller.—Announcement is made in the *Times* of the invention of an improved type of airplane propeller whereby engine power necessary for driving the airplane will be lessened and the vibration of the machine will be much reduced. The new type of propeller arises from the addition of a number of "veins" or flanges made of aluminum to the existing type of propeller. These "veins" are about 6 inches in height and run parallel across the surface of the propeller at a distance of about 1 foot from each other. There are eight at the drive side, four at each end of the blade and six on the wind side in similar positions. It is claimed that by this arrangement the air is properly directed past the propeller blade faces with the result that there is an avoidance of the air losses from the blade ends, which through natural causes take place in the present type of propeller, making possible a maximum thrust with a minimum expenditure of power.

A Pumping Plant for the Airplane.—Herr Fokker's excellent airplanes are too well known to require elaboration here. However, we note in looking over the plans of his latest creation, the "Fokker F III," a passenger-carrying monoplane, that he has made use of a tiny power-driven pump which serves to transfer gasoline from the usual supply drums to the airplane tanks. The pump is mounted near the port side of the engine housing. From this pump a length of rubber tubing, normally coiled up inside the engine housing, can be taken outside the machine and its free end inserted in a gasoline can or drum. A few strokes of the pump soon transfers the gasoline to the airplane tank, and the pump is ready for the next can or drum, and so on. The entire operation of filling the airplane's tanks—and airplanes of such proportions seem to have an insatiable appetite for fuel—can be accomplished by one man in a few minutes, and there is no slopping over and spilling the gasoline all over the machine.

Three New Fog Devices to overcome the drawbacks of mist and fogs to airmen are stated to be under discussion by British authorities. The first consists of the "laying along the route traversed by the airway of a powerfully charged electrical cable. This automatically sends up into the air a constant series of signals." By keeping his machine in such a position that the strength of the signals is kept constant the airman is assured that he is flying along the cable line. The second makes for safety in landing when the ground is not visible, and consists of a wire, with a weight attached which is lowered from beneath the machine, when the weight touches the earth the airman learns that it is time to "flatten out" his machine. The third is called the "artificial horizon." It is "a gyroscopic instrument which shows an artificial horizon line always in front of the pilot and enables him to detect instantly when his machine is heeling over too much sidewise in its relation to the real horizon, which is temporarily invisible. A tiny model airplane poised above the artificial horizon line mimics precisely the movements of his own machine."

The "ZR-2" in flight This British-built dirigible, purchased for the use of our Navy, measures 700 feet long and has a cruising range of 9000 miles

Our "ZR-2" Airship and Its Shed

Some Details of the Giant Dirigible and the Huge Hangar To Be Used by the U. S. Navy

By George H. Dacy

A HUGE work of aerial construction with a capacity of 2,720,000 cubic feet, with a total length of 700 feet and 85 feet wide with a gross lift of 84 tons and an available lift of approximately 45 tons, which consists of gasoline oil, crew, cargo and armament with a full speed velocity of 75 miles an hour and a cruising speed average of 50 miles an hour with commodious and comfortable accommodations for a crew of 42 men and officers, the "ZR 2," the largest airship ever built, at this writing is about to undertake a record breaking trip from Howden, England, to Lakehurst, N J

In July, 1919 the British airship, 'R-34,' made the trip from East Fortune Scotland to Hazelhurst Field, L I, in 108 hours and 12 minutes.

The 'ZR 2' was built at the Royal Airship Works, Cardington, Bedford England It is to be piloted to the United States under the guidance of Commander L. H Maxfield, U S N, with a crew of 30 men and 12 officers of the U S N

The gigantic dirigible which Uncle Sam purchased from England is so huge that if it were placed in Times Square, New York City, there would only be enough space left to walk around the enormous mechanical bird The Capitol Building at Washington, D C, is only 25 feet longer than the "ZR 2," while if the ship could be stood on end beside the Washington Monument, her tail would tower 150 feet above that memorial skyscraper The top of the Woolworth Building in New York City is only 92 feet higher than the peak point which the airship could reach in this position

The motive power of the mammoth aerial flier consists of six 350-horsepower (Sunbeam Cossack) motors located in six power cars. She carries 10,400 gallons of gasoline, which gives her a cruising radius of 6000 miles at full speed or about 9000 miles at cruising speed The propellers on two of the power cars are equipped with reversing gear, which enables the ship to check her speed at will or even to fly astern The dirigible is controlled from a special control car situated forward, which is similar to the bridge of a ship "It permits the commander to handle this airship exactly as does the captain of a sea going vessel A complete communication system consisting of telegraphs, ship telephones and voice tubes, expedites the transmission of orders All orders to the power units sent out over the engine telegraphs are repeated back to the control car before being put into execution. The "ZR-2" is also equipped with a radio set that has a sending radius of about 1500 miles, and it is also provided with a wireless telephone and a radio direction finding set

The "ZR 2" is about 500,000 cubic feet larger than the huge German Zeppelin L-71," which the Huns built to bomb New York City, and which was surrendered to Great Britain under the terms of the Peace Treaty The "ZR-2" was designed expressly for naval purposes, and paramount importance has been accorded those facilities which admit of the attainment of maximum altitude The construction of this ship marks a very definite advance in airship practice, as it is the pioneer ship of purely new design and arrangement and not merely a copy of previous German ships. In general principles, the hull structure is of standard type such as was used in the Zeppelin airships, but a very considerable saving of structural weight has been effected by a large number of improvements in detail It is built of duralumin, and consists of a number of longitudinal, lattice girders connected transversely by other lattice girders which form a series of rings, the longitudinals and rings being braced by wires. This structure contains 14 compartments in each of which is a gas bag made of fabric and goldbeater's skin Goldbeater's skins are obtained from the outer coverings of the intestines of a cow Only one goldbeater's skin results from each cow that is slaughtered and it would consume all the cattle on several of our largest western ranches to provide the 60,000 skins necessary to line the hydrogen gas bags of the 'ZR 2.'

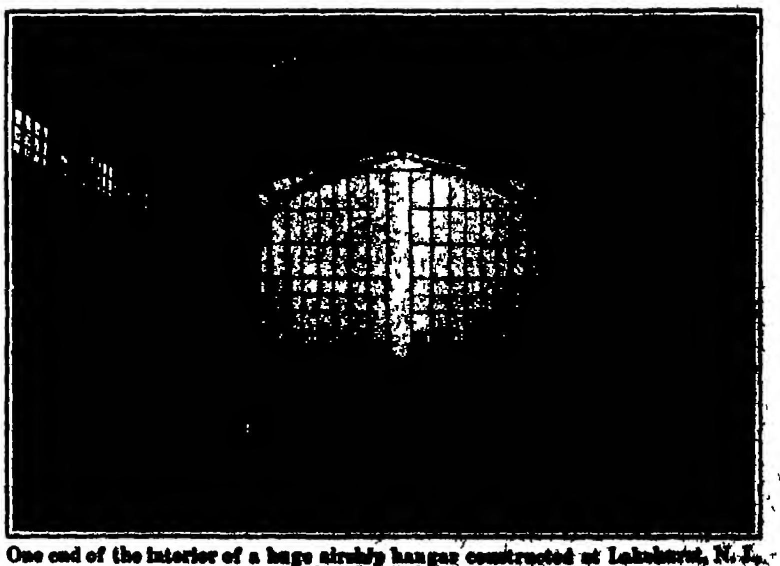
> *As we go to press, cable dispatches tell of the tragic loss of "ZR-2" with the majority of her American crew Comment upon the disaster will be found in our editorial columns.*—THE EDITOR.

If the outer cover of the "ZR-2" were spread on the ground it would cover an area of more than 4 acres. If all the piano wire used in this Goliath of airships were placed end to end, it would reach over 60 miles. This wire is used as stays and braces, the structural strength of the ship being largely dependent on this reinforcement There are also over 20 miles of duralumin channel sections used in making the girders in the hull of this novel air boat Inside the bottom of the airship and running from end to end, is a corridor containing the aluminum petrol tanks, the fabric water ballast bags, accommodations for bombs for wartime uses, and the sleeping and living quarters of the crew This keelway is 8 feet wide and 7 feet high The quarters are furnished with comfortable bunks, benches, chairs, tables and several talking machines. Each power car is equipped with a special cooking arrangement which admits of the expeditious preparation of meals by the utilization of the hot exhaust flames from the motor as sources of heat.

The largest airship hangar in the world has been built at the Naval Air Station, Lakehurst, N J., where the "ZR-2" is to be housed and where, potentially, our Navy intends to construct the first rigid airship in this country The inside, clear dimensions of this mighty garage for air-going craft are. width, 258 feet. length, 808 feet, and height, 172 feet. The building has the largest clear roof area of any structure ever built in this country, and to obtain this enormous roof surface, the overall dimensions of the hangar are width, 350 feet, length, 943 feet, and height, 200 feet The entire Capitol Building at Washington could be placed inside the hangar and even then there would still be plenty of room. The inside volume of the structure is seven times larger than that of the Woolworth Building If the hangar were flooded with water, two of our largest battleships could sail through it side by side

The building is constructed of three hinged steel arches and towers, large, self-supporting steel doors being placed at both ends. Each door is 177 feet high, 136 feet long and 77 feet deep and is composed of two self-supporting leaves operated by electricity and rolling out on steel tracks set in concrete. The steel used in this mammoth building weighs more than 8000 tons; the corrugated asbestos siding used would cover $4\frac{1}{2}$ acres and the steel sash more than 2 acres of ground area Railroad tracks and docking rails extend the entire length of the hangar The building is equipped with elevators, stairways, offices, shops, storerooms and a cafeteria, all of which are located outside the clear floor area, in the space available at the foot of the towers. The hangar cost approximately \$3,000,000. A large power plant for furnishing electricity for operating the doors and lighting the hangar and other buildings and for furnishing steam for heating the hangar, has been built and equipped, as well as barracks and mess halls for 500 men. A large hydrogen plant capable of producing 60,000 cubic feet of hydrogen daily has been built, as well as a gas holder of 1,000,000 cubic feet capacity. A large landing field of 1400 acres has been cleared and graded to permit of the safe landing and handling of the airships.

An interesting feature of the hangar are the docking rails which run through the hangar and cover a distance of more than 1600 feet beyond each end of the building. In effect, they are conduits with narrow slots through which lines reaching from a trolley inside the conduit can be extended to the airship being launched or docked, and are similar in general detail to the ordinary trolley or [illegible] construction with slots, except that [illegible] had to be made for the [illegible] of the airship. A trolley of special [illegible] is provided, which, when not in use, [illegible] along the bottom track in the conduit [illegible] [illegible] for docking or [illegible] [illegible] on the upper bearing on the [illegible] side of the slot rail.



One end of the interior of a huge airship hangar constructed at Lakehurst, N. J., for the "ZR-2"

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Utilizing Tomato Waste

FIGURATIVELY speaking, the glass jar and the tin can are the backstops to America's prodigality in seasons of luxurious plenitude. And yet the waste from commercial canneries and home canning outfits is appalling—the discarded refuse taking the form of trimmings, skin and seed. The utilization of tomato pulp exclusively in the manufacture of catsups and soups renders useless the seeds and skins unless they are recovered as commercial by products.

The business of converting tomatoes into table products, such as soups and catsups is one of magnitude in the United States 120 000 tons of tomatoes being pulped annually in Indiana alone These figures represent approximately 1856 tons of dry waste, or according to classification, 624 tons of seed and 782 tons of skins. This staggering quantity of refuse naturally elicits the inquiry, 'Why not salvage the discarded material to useful purposes?' The chief reason why this question cannot be answered in the affirmative is that the volume of waste at any particular tomato-pulping factory has not been sufficient to justify recovery Then too, the established value of these by products in this country is of recent concern

The investigations by the Bureau of Plant Industry, U S Department of Agriculture, as to the commercial possibilities of canning house waste have likewise developed a counter theory for assembling the material at a central establishment With accessible localities contributing to the total tonnage at the central station, under the discussed plans, the quantity of available refuse would make its fabrication possible Two essential products—tomato-seed oil and meal—are profitably recovered from the canning house refuse The oil is valued as an edible product as well as for its drying properties in the manufacture of paints and varnishes. The meal, a residue after the oil has been extracted, has the possibility of profitable utilization as a commercial stock feed.

The magnitude of the output of tomato refuse in the United States is suggested in a survey made by a representative of the Bureau of Plant Industry who personally inspected 21 of the principal tomato-pulping plants, and supplemented his observations by correspondence with additional enterprises He estimates that 275,000 tons of tomatoes are pulped annually and when supplemented by the tonnage of culls he measures the total quantity of tomatoes thus utilized in terms of 300,000 tons The wet waste from this tonnage will approximate 16 000 tons, which would yield 3000 tons of dry waste

Tomato catsup pulp paste puree and soup are the derivatives of crushed tomatoes when ground in so-termed cyclone machines The latter machinery has been picturesquely described as power applications of the housewife's colander By the commercial process the red pulp and juice are forced through perforations in a screen while the skins, cores and seed are discarded as useless Cyclone waste is the fitting description applied to the outlawed material The quality of the tomato and the relative efficiency of the pulping plant are factors responsible for a variation in the ratio of refuse—ranging from four to ten per cent by weight The dry seed constitute about one half per cent of the tomato

Cyclone waste consists of 80 per cent water A method has been devised and operated on a factory basis whereby the wet seed of the tomato can be divorced wholesale (commercially speaking) from the remainder of the undried material Such a system of seed separation according to Dr J H Schraeder formerly a scientist in the Bureau of Plant Industry will enable the producer to separate the seed from other waste at each tomato-pulping station Continuous of operation, cheap and fool proof are among the virtues claimed for the new method The advantages obviously are to make the producer independent of the necessity of shipping his waste to a central plant when exorbitant freight rates might deprive him of potential profits

The observations as to the recovery of tomato refuse were gathered by Doctor Schraeder from waste-producing stations in Maryland Delaware New Jersey New York, Ohio, Indiana and Illinois the tonnage of raw material handled by these plants for the past five years Cyclone waste from tomatoes was calculated to be five per cent. To assemble 12,500 tons of tomato refuse at

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Water side of Chicago's wrecked elevator, showing the pneumatic conveyor that is being used in the salvage of six million bushels of grain

Salvaging Grain by Suction

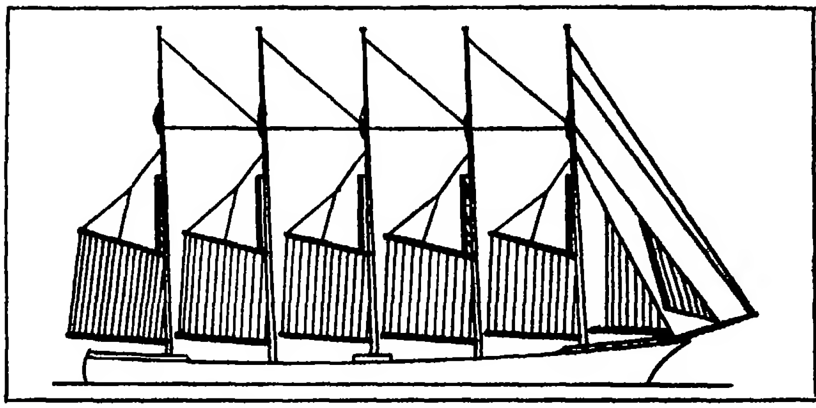
FOLLOWING the dust explosion which wrecked a great elevator at Chicago came the problem of salvaging some 6 000 000 bushels of grain within and around the wrecked structure The handling of this grain by scrapers portable conveyors trucks and manual labor was a slow process and it was decided to use the pneumatic method Two conveyors were installed one on the river front for discharging to steamers and the other at the north side of the structure for loading the grain into cars

The use of the pneumatic system in salvaging this grain is resulting in a very marked saving in cost of handling The labor involved is reduced to a minimum Where a bin containing 30 000 bushels of wheat, oats or corn is to be emptied the suction nozzle is simply placed under the bin and the gate casting knocked off The grain is allowed to flow until the bin is emptied Where the grain and concrete are en masse a flexible hose is attached to the suction duct and the method of operation is quite similar to the ordinary vacuum cleaner except of course on a much larger scale To some extent the grain is cleaned and cooled by the suction conveyor The heavy pieces of reinforcing steel machinery parts and concrete will not enter the duct and miscellaneous fragments which do pass into the line are caught on a screen within the separator tank and cleaned out from time to time

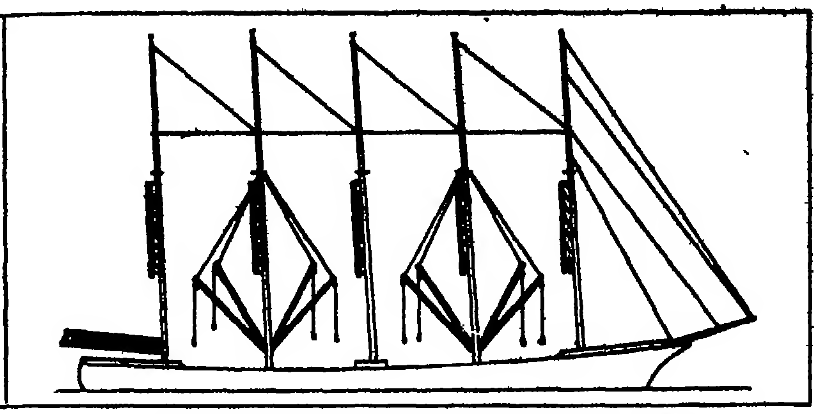
This is the greatest grain salvaging problem on record The workhouse bins with few exceptions remained intact and these were readily emptied by an emergency track through the house and direct spouts to cars Some fourteen great storage bins on the south side were blown open and with but little power available scrapers wagons trucks and portable conveyors were put to work getting the exposed grain into cars placed on an old construction track The double row of bins of the river house were more or less wrecked allowing the basement of this section to fill with grain The two hundred and twenty standing bins of the main plant each with a capacity of 30 000 bushels were lifted as a unit by the force of the explosion and dropped back on their foundations At the same time the blast toward the sides wrenched the bin spouts and many gates loose as though by the hand of a giant Any attempt along the usual lines of salvaging here would have been extremely costly as well as hazardous The pneumatic method solved this problem one or two men doing the work of the large gang that would have been required to pursue any ordinary plan of attack to its doubtful and perhaps even dangerous outcome

Left: Direct-heat drier for tomato seeds. Right: An experimental "moisture expeller" working on a different principle from the ordinary drier

Some of the apparatus by which the tomato seeds and skins may be salvaged in the catsup factory



Snugged down for heavy weather



At the deck; spars of lower sails used as cargo booms

The Motor Clipper

A Motor Sailing Ship That Can Compete with the Ocean-Going Tramp Steamer

By C. O. Liljegren

IN SCIENTIFIC AMERICAN for April 23, Mr Rowland pictured and described a new auxiliary sailing ship, the "Motor Clipper," developed by the present writer during a lifetime of incessant study of the sailing ship problem. To make sure that the vessel was correctly pictured the Editor has kindly asked me to supply missing details in her construction and fittings.

Frankly stated the "Motor Clipper" is a development of and a cross between the American schooner and the racing yacht. The schooners when first seen by the writer in 1895, made an indelible impression because of their simple rig, great carrying capacity, and general handiness in comparison with the then common square rigger. At that time the first four-masted schooners, called "1111," were built and were considered to be wonderful, but there soon followed the five-masted schooner, to say nothing of the six and seven masted schooner, such as the "Wm L Douglas" and "Thomas Lawson," built at the Fore River shipyard about 1900.

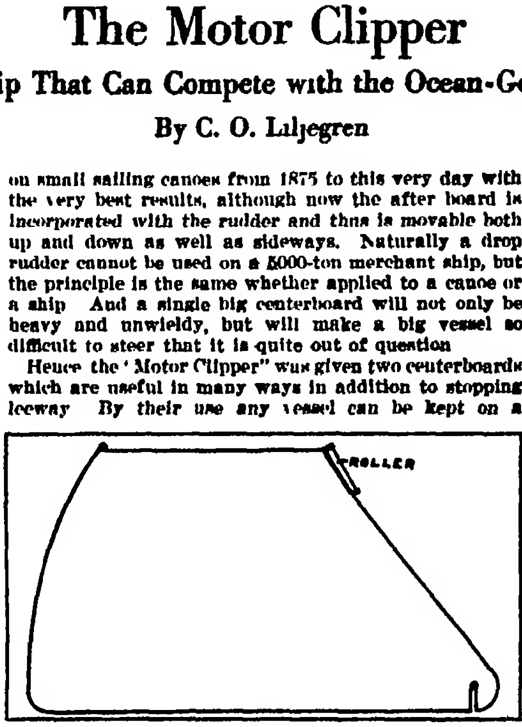
But while watching these schooners and comparing them with the yachts of the period, the writer soon found out that they were badly lacking in one essential point: they could not beat to windward. Consequently their voyages were badly delayed by headwinds, and heavy gales drove many of them on shore. In fact, just like a square-rigged ship, all schooners were in mortal danger every time a gale of wind drove them near a lee shore. Clearly this must be changed if the schooner is to come into her own.

Now, in order to beat to windward like a yacht, three things are necessary: an easy form of hull with small windage," great stability, and leeway stoppers. The United States had highly developed the *centerboard*. Why not use these on large schooners? Of course the writer knew that centerboards had been used on small schooners, but with only mediocre results, this because they were simply copied from the small sailing craft without due attention being given to the great friction in a big centerboard, and to the weakening influence of cutting a big hole in the middle of the vessel, where the strain is heaviest.

On the other hand, sideboards or *swords* have been used on Dutch merchant craft for many centuries with splendid results. In fact, whoever like the writer has seen the clumsy dutch "Koffs" and "Tjalks" beat to windward as fast as many a yacht in a strong wind, must get a profound respect for such a combination of carrying capacity and weatherliness. This proves conclusively the worth of leeway stoppers on merchant ships, for these "koffs," although almost square in their ends, and loaded to the deck line, still can make fast trips.

These swords are simply strong wooden boards attached to the outside of the vessel, and pulled out of the water when not in use. Clearly there must be a limit in the size of the vessel where such simple contrivances can be used, just as with the centerboard. Both can be used only on vessels under 300 tons' register, but what about duplicating the leeway stopper? In fact, twin and even triple swords had been used in Holland about the year 1600, and double centerboards have been used on small sailing canoes from 1875 to this very day with the very best results, although now the after board is incorporated with the rudder and thus is movable both up and down as well as sideways. Naturally a drop rudder cannot be used on a 5000-ton merchant ship, but the principle is the same whether applied to a canoe or a ship. And a single big centerboard will not only be heavy and unwieldy, but will make a big vessel so difficult to steer that it is quite out of question.

Hence the "Motor Clipper" was given two centerboards which are useful in many ways in addition to stopping leeway. By their use any vessel can be kept on a



Steel centerboard with anti-friction roller

straight course with very little rudder work, simply by regulating their depth below the keel. In tacking, the boards are raised and lowered alternately, so that missing stays is never to be feared. Of course some "experts," as usual, will say "It can't be done", but they are always interrupted by someone who comes along and does it. The two centerboards have not yet been tried on a big ship, but they work to perfection in the big model of the "Motor Clipper" herewith illustrated, keeping it on a straight course. Whoever sailed a model ship will understand the difficulty; note the photograph of this model with all sails set, and going at a good speed. It is now a well known fact that models make possible an estimate of the behavior of a full-size ship of the same proportions and form.

In a big ship the chief difficulty would lie in the raising and lowering of the centerboards on account of the heavy pressures and resulting friction. To overcome friction, rollers are necessary, or some kind of ball bearings. Our illustration shows the conical, self-adjusting roller introduced by the writer, applied at the point of maximum effect. The big end bearing is slightly tapered and allows the roller to revolve evenly and in full contact with the centerboard case. The roller almost fills the case sideways, in order to reduce the unpleasant "slapping" of the board in a seaway in light airs. The actual raising and lowering is done from the bridge of the vessel, through a small motor (electric), winches, and strong iron chains, with the cargo winches as a reserve in case of need. The chain needs to be very strong, but in case of a break the board is made to drop out automatically so as to not endanger the tightness of its case, or it can be caught by a wire rope under the keel.

In a wooden vessel it was almost impossible to make the case watertight, but this is comparatively simple in a steel ship, and need not cause any anxiety except in grounding. On the other hand the forward centerboard will give warning of shoal water, possibly in time to save the ship. And if the board be bent, it can be dropped at will. Such things count as dangers of the sea against which no vessel can be made proof.

Wind power as compared with steam power costs nothing beyond the relatively small outlay for a ship's sails, masts and rigging, and subsequent repairs. It is largely a question of applying wind power scientifically. Unlike every other source of power, it can actually work against itself, and force a ship to windward against the very wind that drives it forward. The machine-driven vessel's main advantage lies in being to a certain degree independent of wind and weather. If the same independence can be secured in a sailing vessel, even granted a decrease in speed, the sailing ship must ultimately prove a serious competitor of the mechanical ship for certain classes of freight and service.

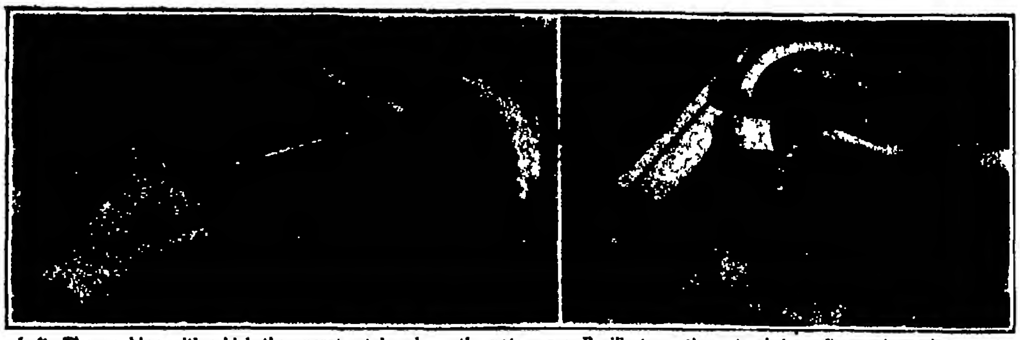
Practical sailing men, that have seen hundreds of sailing ship logs, agree unanimously that only calms and head winds have prevented sailing ships from making just as smart passages as any tramp steamer. For taking a ship through calms some kind of machinery is clearly necessary, but it must be cheap, easily applied, and like the "maid of all work," be put to many uses on board; propulsion, hoisting cargo, sail handling, lighting, pumping, etc. And above all, the machinery must not *spoil the sailing qualities of the ship;* it must be strictly auxiliary. This condition rules out all twin screws because of the extra cost of duplicating the machinery. In December, 1916, the writer warned strongly in the *Pacific Marine Review* and other shipping journals against twin screws. The warning was very little heeded by shipowners; but many sailing ships with twin machinery are removing it. This has been done by

(*Continued on page 171*)

From a photograph of an eight-foot model of the motor clipper ship, under way

Typewriters for the Blind

ALTHOUGH it has been demonstrated that the blind man can learn to operate the ordinary typewriter with a fair degree of success, this machine is after all not suited to the sightless operator German inventive ingenuity for some reason has paid more attention to this matter than we have on this side of the water, with the result that at least two very acceptable machines have been put out, so designed that the handicap of the man who cannot see is reduced to its lowest terms. The one is merely a substitute for the usual typewriter, and compares rather poorly with it in speed. The other is something more than this, being designed for letters of which numerous copies are wanted The letter is taken from oral dictation in the first instance, and typed, in Braille characters, on the tape Then this tape is run through the instrument under the blind operator's fingers, and he types off, in the ordinary alphabet, as many copies as are desired Both machines are distinguished by having the keys marked in Braille characters, so that the typist can the better detect an error.



Left: The machine with which the operator takes down the notes on a Braille tape the notes being afterwards read from the tape by the sense of touch and then transcribed. *Right:* A miniature typewriter of more conventional design for the sightless operator

German typewriters for blind workers

A Mystery Picture and Its Explanation

THE reader might be allowed a generous number of guesses as to the subject of the curious picture presented herewith, with considerable confidence that he would not hit it right. These mysterious bows do not represent chair-backs, nor yet scrapped submarines they are merely some 2000 motor trucks that were submerged to the point shown by the flooding of the Rhine bottom lands where they *stood* They are the property of the American Army of Occupation, and were waiting for somebody to come along and find a use for them when the flood over *took them It will be seen that* the tarpaulin bows and, in some cases, the tops of the cabs, are all that is visible But the trucks stood up so well under their prolonged wetting that they were *successfully salvaged, and it* is even said that they are being sold now in the United States.

Two thousand American motor trucks, intended for the Army of Occupation, submerged in the waters of a Rhine flood

Oil for Greenhouse Fuel

COAL is the common fuel used in heating greenhouses In the United States the industry engaged in producing flowers and vegetables under glass is extensive, and for reasons which can readily be appreciated, the coal strike brought its worries to the men with large investments in greenhouses An interesting new development in this industry, partly traceable to the difficulties of coal shortage, is the adoption of oil for fuel

New England claims to have the pioneers in this new use of oil for fuel. Two florists near Providence have equipped their houses with oil-burning apparatus, the installation being sufficient to heat their whole ranges. More recently, in the great Arlington market garden district near Boston, a leading market gardener has adopted oil fuel. Interest in these most intensive of horticultural industries is so intense that the special Market Gardeners' Experiment Station at Lexington, Mass., is installing oil-burning apparatus, and will collect official facts and figures bearing on the desirability of the new fuel

From the standpoint of the veteran greenhouse man there is a bigger side to the change from coal to oil than recent coal strike experiences suggest He is intensely interested in oil because of what help it may contribute to a solution of acute labor problems. With oil it is not necessary to shovel coal or take out ashes Oil, it is declared, maintains a remarkably even heat, with a minimum amount of attention keeping the greenhouse *temperature exactly as desired*

If early results are confirmed, there is sure to be a rapid drift into use of oil instead of coal We may yet see the day when the greenhouse which is a coal user will be regarded *as a curiosity Market gardeners and* florists are typically enterprising men and in a situation of this sort will let no grass grow under their feet

Transmitting Photographs and Drawings by Radio

FOR some time an interesting series of experiments has been under way at the large radio station at Annapolis, Md, having as the object the transmitting of photographs and drawings by radio to a receiving station at Malmaison, near Paris, France This series marks but another step in the development of the Belin system of photographic transmission which was described in our columns last November when M Edouard Belin succeeded in transmitting photographs between St Louis and New York City over the usual telegraph lines This time, however the transmission is by high power radio which obviously introduces a number of complications

The Belin principle is quite simple and ingenious. The photograph to be transmitted is transferred on to a brass cylinder and so treated that its image is reproduced in high relief The cylinder is then placed in the transmitting unit, where its irregular surface presses against the stylus of a sensitive microphone The irregular surface varies the pressure on the microphone and hence its electrical resistance and in that manner modulates an electric circuit in direct proportion to the photographic values. A special synchronizing device sends out a synchronizing signal at regular intervals.

The receiving side consists of a highly sensitive Blondel oscillograph which carries a tiny mirror on its strings. The strings are placed in oil so as to make them dead beat while the mirror swings about on its vertical axis. A source of light casts its rays on the mirror, which in turn reflects them on to a screen of graduated transparency behind which is a drum covered with a piece of sensitized paper This drum turns in perfect synchronism with the transmitting drum through the means of the synchronizing *signal and special mechanism* which our available space does not permit us to describe here. As the modulated current or signal strength reaches the receiving end, the tiny *mirror is deflected more or less so* that its beam falls on any part of the graduated screen that corresponds with the image at the transmitting end In this manner more or less light falls on the sensitized paper of the cylinder which is then developed in the usual manner

A simpler transmitter and receiver arrangement calls for a plain make-and break device at the transmitting end operated by the surface irregularities, and no graduated screen at the receiving end This arrangement is for the transmission of drawings cartoons facsimile type matter or hand writing, maps, and all other matter in plain black and white without the half tone gradations of the usual photograph

In the present experiments, which are being conducted by Messrs Marcel Touly and Gaston Johanneau of M Belin's staff, only plain black-and-white transmission has been undertaken thus far The difficulties encountered have been mostly in the way of getting the Belin apparatus to modulate the powerful output current of the big arc generator at Annapolis Over sixty relays have to be actuated in order to handle the transmitting current, and it stands to reason that in this large number of relays some

(Continued on page 173)

The Belin transmitting apparatus employed in transmitting facsimile messages and drawings between Annapolis, Md., and Malmaison, France. Note the big generator in background

Industrial Alcohol

Where It Is to Come From, and Some of the Things We Are to Do With It

By Harry A Mount

ATTENTION has already been called, in articles which have previously appeared in the SCIENTIFIC AMERICAN, to the growing importance of alcohol as a fuel The prospect is, indeed that within the span of a very few years, alcohol or fuels with an alcohol base will largely or entirely replace gasoline as a fuel for motor cars But as important as this prospect is, it can hardly overshadow the general industrial usefulness of alcohol especially in the chemical industries, which are just coming to the fore in America

The making of alcohol has been an accomplishment of nearly every race for some 3000 years but the product was used largely for beverage purposes It is only within comparatively recent years that alcohol has come to be of commercial importance and the history of commercial alcohol is even more recent in this country The industry in nearly all countries has so far labored under two severe handicaps. Alcoholic drinks have been a favorite source of governmental revenue and it has taken a long time to convince taxing agencies that they ought to differentiate between alcohol for beverage purposes and that used in industry

Before the war very little industrial alcohol was used in this country The first large plants furnished the alcohol with which we made munitions for the allies before the United States entered the war Later large amounts were used to supply our own armies. It has been stated that approximately 52,847,117 proof gallons of denatured alcohol were used in supplying our armies with explosives poison gas, etc It is apparent that in time of war a well developed alcohol industry is essential It is undoubtedly true that one of the contributing reasons for Germany's strength was her large alcohol plants, which in 1912 were producing over 41,000,000 United States gallons annually for commercial purposes

Beginning with a production of 3,084,950 gallons in 1907 the alcohol production in this country grew gradually until in 1914 the production was over 17,000,000 gallons In 1916 the production had jumped to 84,000,000 gallons and in 1918 over 90,000,000 gallons of denatured alcohol for industrial use was produced Practically all of this alcohol was used in the country and the large increase can be accounted for by the expansion of the dye and other chemical industries

It would be almost impossible to enumerate all of the industrial uses for alcohol But even a brief survey of the field cannot fail to be impressive

The most important use for industrial alcohol is that of a solvent Indeed chemists say that the only solvent of equal importance is water Alcohol as a solvent for dyes and confectioners' colors is of great importance In the development of gelatine food products considerable alcohol has been used as a solvent for the coloring matter If it were not for the solvent properties of alcohol we would not have such commodities as perfumes, liquid soaps, toilet waters liniments, flavoring extracts, etc Large quantities are used in this country in the making of "solidified alcohol" as a fuel under chafing dishes and small portable stoves.

Alcohol is used as a raw material in the making of ether, mercury fulminate, chloroform certain toxic gases such as mustard gas, and in many other drugs and chemicals. Alcohol lightens the housewife's burden in many well known ways. Its medicinal value is also well known and large quantities are used in hospitals.

Alcohol is also used in quantities as a dehydrating agent in the manufacture of photographic films and in the preparation of photographic prints It is used as a precipitating agent in a number of chemical processes. It enters into the manufacture of inks, celluloid, shellacs, disinfectants, etching solutions, soldering fluxes, etc

After exhaustive tests of various anti-freeze mixtures for auto radiators, the Bureau of Standards has recommended alcohol as least harmful

A British Government report reveals the use of alcohol in important quantities in the making of many other articles, as electric lamp filaments, linoleum felt, fireworks, matches, steel pens, artificial silk, rubber, printing, dyeing and cleaning operations in laundries, etc

Some idea of the tremendous importance of the industry can be gained when it is realized that this is only a partial list of the uses to which alcohol is put, and that new ones are being constantly added.

One of the newest, for instance, is its utilization in the purification and separation of gum turpentine Only a small percentage of the resin produced now is marketable because of bad color It has been found that gum turpentine is soluble in alcohol and foreign matter such as twigs and insects can then be easily removed Distillation separates the alcohol, which can be used again, from the turpentine and resin, which are clear and of the highest grade

With all these uses the factors of production and price are vital "When will we have cheap fuel alcohol?" is a question rivaled in importance only by the other one "Why is alcohol so high?" The chemist insists that the raw materials for the making of alcohol are on every hand in limitless and permanent supply that the extraction of alcohol is one of the simplest of all chemical processes, that alcohol fuel is more satisfactory than present-day gasoline In a word, that alcohol offers a permanent solution for the serious fuel problem caused by a shortage of petroleum

Small consolation this for the motorist who continues to buy fuel for his car that costs more and more and is of constantly declining quality! The supply of gasoline already is less than the demand and the promise for the immediate future is less fuel and more motor cars If alcohol can make good as a motor fuel isn't this the time to do it? Why hasn't the chemist made good his promise?

TO the average citizen "alcohol" is that forbidden ingredient of certain beverages which imparts thereto the so-called "kick" As a matter of fact, alcohol is no doubt the most important of all chemicals useful in our industries Millions of gallons of it are used each year in the production of an almost endless list of commodities Some industries depend upon alcohol for their very existence, for there is no substitute for it in certain operations And both the production and usefulness of industrial alcohol are increasing in this country at such a rapid rate that it is becoming a very large factor in our economic situation This is the story which Mr Mount has for us this week—THE EDITOR.

These are some of the thoughts of the average motorist who has followed the fuel situation in recent months And to add to his confusion there have appeared such statements as those of a Brooklyn inventor that he was ready to place on the market a motor fuel to sell at five cents a gallon the base of which is alcohol And then comes the following, credited to Henry Ford

"I am now making the best fuel my tractors can use out of straw I have an inexhaustible supply of fuel on my farm and believe the day is coming when we will extract the alcohol out of fruit for fuel and use the rest for food I am putting up a $35,000 plant now to manufacture alcohol from straw alone just to show people that it can be done"

The "Inventor" referred to above is now in jail and his five-cent fuel is branded as a swindle A famous authority on industrial alcohol says of Mr Ford's well-intentioned effort

"This process is still of an experimental nature and has no commercial significance at present."

As for the chemist he has done his work well and he is now able to convert into alcohol a great variety of substances, many of which are now wasted, but he has run plump into the laws of economics and so far his product is not able to compete with gasoline in price

It can readily be seen, therefore, that the importance of alcohol as an immediate savior for the motorist ought not be overestimated. But on the other hand the importance of this fuel a few years hence ought not be overlooked. It is the purpose here to outline briefly the problems the chemist faces in developing a cheap alcohol fuel and to tell how he has set about solving them.

There are several methods of deriving industrial alcohol. The one used now almost to the exclusion of all others is the fermenting of a mash from some material containing a large amount of sugar or starch and distilling and refining the resultant alcohol.

The process is very simple, although some of the latest apparatus for producing large quantities of alcohol continuously is rather complicated. The fermentation process has been in use for some 3000 years and chemists are ready to admit that there is small chance of any large improvement There is a large number of possible raw materials for this process including most of the grains, many tubers such as potatoes, turnips, mangolds, etc., nearly all fruits, molasses, and other materials

Large quantities of industrial alcohol were made in Germany before the war from a potato grown especially for the purpose In this country much of the alcohol is manufactured from "black strap" molasses, which until a few years ago was a waste product of the Cuban cane sugar industry The chief difficulty is that all of these products, which are available in sufficient quantity, are also useful as food and their price does not depend on the alcohol they will produce, but on their value as foods. A writer in the SCIENTIFIC AMERICAN has recently pointed out that if one-fourth of our corn crop of last year had been used to produce industrial alcohol, there would have been an amount equal to our gasoline supply This is an interesting speculation, but engineers engaged in the serious business of producing alcohol point out that if such a large part of our corn crop had been diverted to the making of alcohol the price of corn, and consequently the price of alcohol, would have soared to impossible heights. They are agreed that there is very little hope of cheap alcohol so long as we must depend for raw material upon products which can also be used as food.

There are however, many materials from which it is theoretically possible to obtain alcohol, which are about us in inexhaustible quantities and which are not used for food Alcohol may be had from any material containing cellulose, such as wood, grasses and vegetation of all kinds. As Mr Ford has shown, it is perfectly possible to make alcohol from hay or straw, but the difficulty is with the process. It is first necessary to break down the cellulose so that sugar is obtained and this is fermented in the usual way It requires, however, a complicated process and a large amount of power to first obtain the sugar The process has proved so expensive that the alcohol from this source cannot compete in price with that made from food products. There is, of course, the chance that someone will find a way to do this cheaply but the odds are against any such discovery because some expense will always be necessary before the starting point of the fermentation process is reached.

Is there, then, no chance that we shall have cheap alcohol? There are at least two recent developments which hold very great promise, although neither of them is as yet commercially practicable

In one of these the bacteriologist has come to the rescue with the promise that he will soon discover a "bug" or bacterium which will have the power to convert cellulose materials directly into alcohol. The promise is a plausible one for the reason that this very thing has been done on an almost infinitesimally small scale. It is admitted that a new bacterium must be found to accomplish the result on a commercial scale. An intensive search for this "bug" is being made by competent scientists and there is very good reason to hope for success. If this search ends favorably the effect will be revolutionary.

The second basis for the hope that cheap alcohol is not far off is in experiments being conducted largely in Europe, to extract alcohol from mineral sources. A chemical engineer who has just returned from an investigation of activities reports that very great progress is being made and that literally hundreds of experiments of a more or less extensive nature are going on. Europe has always led America in the manufacture of industrial alcohol chiefly because we have so far been blessed with a plentiful supply of petroleum which had only to be taken from the ground.

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From Swords to Plowshares

A Survey of the Post-War Activities of the Huge Krupp Works

THE Frederick Krupp Corporation comprises the cast steel manufacturing plant at Essen, the Gruson Works in Magdeburg Buchau, the Germania shipyard in Kiel, the Frederich-Alfred Mine in Rheinhausen on the lower Rhine, the Annen Steel Works in Annen, Westphalia, as well as the independent Middle Rhine industries, the iron and coal mines, the land that was formerly the proving grounds at Essen, Neppen and Tangerhütte, and many other units.

On July 1, 1914, all the above plants and mines employed 80,824 workers, of which number 41,796 worked in the Essen Plant. It was generally believed the world over, before the war that the Krupp Works manufactured war material only But few people know that war material actually formed but a very small percentage of the total output of these works. The importance of the company as regards production of peace products, can best be judged by the fact that it supplied 1/5 to 1/3 of all Germany's railway materials, such as rails, ties, wheels, axles, frames for locomotives, boilers, fireboxes and forged pieces. There are, therefore, very few trains in Germany that are not fabricated out of Krupp steel.

The principal articles manufactured in the Krupp foundry before the war were Steel pieces of all qualities (especially high grade steel) special automobile and tool parts, railway and shipbuilding material Among the finished products war material was first, such as cannon with full equipment, ammunition, rifle barrels, armor and huge armor plates. At the Gruson Works stampings and forgings for mining and cement-making machinery were manufactured

The Germania shipyards at Kiel built battleships, fast passenger and freight steamers, floating dry docks, turbines, oil engines, boilers, etc

The Frederich-Alfred Mine supplied iron ore and timber as well as most everything made from these materials, such as bridges, buildings, etc

The declaration of war on August 2, 1914, necessitated a radical change in the interest of National defense. Plans for increasing the output of the organization were immediately effected, the plants operating on a peace basis being far from adequate to meet the situation The Gusstahl Plant in Essen alone was enlarged from 241.2 to 395 acres. The number of employees in the Essen Plant increased from 41,796 to 114,000 Similar increases were effected in all the other plants bringing the total employed in 1918 to more than 172,000

The armistice conditions and the Peace Treaty of Versailles made it necessary for the organization to revolutionize its gun and ammunition works. On the other hand the open hearth furnaces and wood work ing plants continued operation as usual as long as the coal supply lasted It was more difficult to find work for the men who had made war materials only In the steel works at Essen, after the armistice, the first work done was the repairing of locomotives and cars, which was a necessity on account of the heavy wear and tear on rolling stock during the war At the same time the manufacture of locomotives and cars was begun. The construction of this railway equipment was accomplished in parallel buildings composed of 19 shops having a floor space of 74,000 square meters (796,000 square feet) in which today 5000 men are employed giving an annual output of 300 heavy locomotives and tenders and 2500 15-ton cars The manufacture of commercial automobiles, trucks for special purposes, agricultural machinery and machinery for the textile and paper industries is carried on, as well as that of internal combustion engines, turbines and machines for making office furniture, counting and adding machines

By taking up all these industrial branches it was possible in a few weeks to resume working with the force which the armistice cut in half There was a gradual increase until on July 1, 1921 more men were employed than before the war The working day was reduced from 10 to 8 hours, so that a greater force was required to produce the many lines

The program of the Essen Works, including the production of the raw materials which were made before the war, includes the following

Special steel, rolled, forged and in condition for further processes. Casting steel, forging steel, cast iron, silico iron for casting, steel rolls, steel plates for safes, tool steel, pressed steel, tin and tin articles, spiral leaf and other springs, gears, bolts and nuts, drills, metal packing, compressed air tools, pumps and hydraulic machinery gear boxes for steam, water and electric-drive machinery, starting motors, roller bearings, mine cars and counting mechanisms

Cast steel shapes (structural steel) for shipbuilding and forgings, crude oil motors marine oil engines, marine gear boxes, steam boilers and Diesel engines electric tools and lifting magnets Precision tools and instruments, cash registers, motion picture projectors, locks, keys, surgical instruments of all non rusting steel

Milk separators, potato-diggers, reapers and binders, mowing machines and tractors for all the above Spinning machines and parts and machines for paper making and textile industry Locomotives, freight cars, including automatic dumping cars and complete rail road signal roadbed and overhead equipment Steel and steel products for automobile and car construction, motor trucks, street sweepers, sprinklers and washers, mill refuse wagons with tractor motor road rollers, industrial cars locomotives and cable system, steel and steel products for aircraft industry

Besides all the difficulties which the change brought about, the corporation naturally has to suffer from the economic stress of Germany The coal shortage which was aggravated by the conference at Spa, is felt in all the works, especially where raw products are produced Most of these latter works had to close down. The reduced output of such products of raw material diminishes the quantity of finished products It is true that the increased use of "wood coal (brown in color) in place of anthracite or in combination therewith, helps out to a certain extent.

From this general coal shortage in Germany, the Krupp Works suffer the most, but they naturally cannot change the situation

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Height and Velocity of Flight of Migrating Birds

To the Editor of the SCIENTIFIC AMERICAN

On reading your note in the SCIENTIFIC AMERICAN of July 9, concerning recent measurements of the velocity of flying birds, it occurred to me that two instances of trigonometrical measurements of the height and velocity of migrating ducks and geese, may be of interest. From *Science*, January 1, 1897, I quote

"Measurements of the heights and velocities of clouds are now being made at the Blue Hill Meteorological Observatory by Mr Rotch as part of an international scheme for such work. The measurements are made with specially constructed theodolites in which a large conical tube with crossed wires at one end and an eyepiece at the other replaces the ordinary telescope.

"On the morning of December 3, while Mr S. P Fergusson and I were engaged in measuring clouds, a flock of ducks passed across our base-line, which is 2390.3 meters in length. We succeeded in getting one simultaneous set of measurements on the apex of the flock from which its height was calculated, and one or two independent subsequent observations, from which the velocity was calculated. The height was 288 meters above the lower station, which is situated in the valley of the Neponset River.

"The velocity of flight calculated from this measurement of height, and from the angular velocity measured at one end of the base-line is 21.4 meters per second, and from the angular measurements made at the other end of the base-line is 21.3 meters per second. The wind was very light, having a velocity of only one meter per second, according to the automatic record at the Blue Hill Observatory, 180 meters above the valley. The direction of the wind was from [illegible] and the ducks were flying from the northeast. These observations were not in our program, but they may be of interest to ornithologists and students of aeronautics.—H Helm Clayton, Blue Hill Observatory"

Again, from *Science*, of April 9, 1897

"During the three days ending March 22 numerous flocks of geese were seen migrating northward, or rather northeastward, since they were following the general trend of the coast line, which, in New England, *is nearly northeastward north of Cape Cod* On the morning of March 22, while Mr A E. Sweetland and I were measuring clouds, at the ends of a base-line 1178.4 meters in length, extending from the Blue Hill Meteorological Observatory to the base of Blue Hill, we succeeded in measuring, with our cloud theodolites, the height and velocity of flight of one of these flocks of geese So rapid is the velocity of flight that the flock was visible to the observers only about two minutes, but during that time two sets of measurements were taken with the theodolites on the leader of the flock The first measurements, at 8 49 a m, were accurately taken at the Observatory station, but were only approximate at the other station. The second measurements, at 8.50 a.m., were accurate and simultaneous at both stations. Using the second set of observations at both stations for the height and the two sets of observations at the Observatory station for velocity, the calculations gave the height as 276 meters above the Neponset River valley, or 293 meters above sea level, and the velocity of flight as 19 8 meters per second The direction of flight was from southwest to northeast.

"The self recording instruments at Blue Hill Observatory, 180 meters above the river valley, showed that the wind at the time of the measurements was from west-northwest with a velocity of 4 meters per second. The height calculated from the first set of observations at the two stations was 288 meters above the river valley This result, though not considered strictly accurate, serves as a good check on the adopted value which is given above. On a previous occasion as described in *Science* of January 1, p 26, we found a flock of ducks flying from the northeast at a height of 292 meters with a velocity of 21.3 meters per second. The close agreement between the two results is suggestive, though it may have been accidental."

At the time, we were informed by ornithologists that these were the first measurements of the kind ever obtained. I have not learned of similar measurements since 1897, except those you refer to, but am very unfamiliar with the literature of ornithology

A base-line less than 400 meters in length should be sufficient for observations of this kind, and need not be equipped with telephones. The accumulation of a satisfactory amount of data for birds of all kinds is likely to require much patience, at least in the Eastern States, for the reasons that usually only one or two observations can be secured on any flock of birds in *flight and it is necessary for the observers to be on* the alert continuously during long periods of time

S P FERGUSSON

Washington, D C

Something New (?) in Brick Walls

To the Editor of the SCIENTIFIC AMERICAN

I was interested in an item under the above title in your issue of July 9, 1921 "Something New in Brick Walls Using Standard Bricks —King Solomon was right—for in the year 1880 I rented a house at Walton on Thames about 40 miles from London which had walls built as described (I would judge it to have been about 70 or 80 years old at that time), and found it so cool and comfortable that I continued my tenancy to Christmas and found it both warm and dry in the winter I can most strongly recommend this construction but it is not new

E. F BATEMAN.

Saskatoon, Sask.

The Paradox of Civilization

To the Editor of the SCIENTIFIC AMERICAN

The writer of the editorial under the above head in your paper for July 30th, is evidently alarmed over the approaching exhaustion of our coal deposits. He seems to infer that as soon as the coal has been all consumed the savage and barbarian will again be masters of the earth

Would it not seem more reasonable to prophesy that, as the time draws near when the coal will be gone, the need for power, heat and light will be met by substitutes, perhaps better than coal, without coal's draw backs and inefficiency? There are many sources of energy which could, within the bounds of possibility, be developed to take the place at present held by coal Among them are water power, solar heat, alcohol produced from vegetation, the vast reservoir of energy stored in the earth's interior, the wind and the waves. Why despair of the future of civilization merely because we may burn up all the coal?

East Canaan, Conn D C CANFIELD.

Virgin jungle, cleared and plowed for the planting of young rubber trees

Cultivated Rubber

How the "Plantation" Has Made It Possible for the Grower to Keep Pace with the Demand

By G. A. Orb

It is a pertinent fact in the world of today that the wheels of industry must never stop mills and factories must operate day after day—the demand is ceaseless Hence when Mother Nature moves too slowly to supply these demands of modern industry with sufficient raw materials for its insatiable maw, then must the brain of man come on the job and devise ways and means to meet the ever increasing need

No greater romance is to be found in the world of industry today than that of rubber rubber, not alone for tires that do heavy duty in the commercial pursuits or transport my lady on her round of pleasure, but rubber for the thousand and one other needs of mankind

It seems a long way from the jungle of the tropics to the automobile tire yet had this same jungle not been made to produce instead of being merely a shelter for wild life motor transportation would not be where it is today

Two decades ago "experts' declared that if the automobile industry was to develop much further it would be necessary *to find some other resilient substance* than rubber from which to make automobile tires Yet a far different result has been accomplished not only do we have sufficient rubber for tires but for a thousand uses never dreamed of in 1900

Cultivation of rubber was first attempted in 1870 when the seeds of the Para tree (*Hevea Braziliensis*) were planted in Kew Gardens London the next year it was introduced into Ceylon and later into the Federated Malay States Straits Settlements, southern India, Sumatra, Java, and Borneo And it was in 1900 that the first trees of these far eastern plantations came into bearing, producing four tons of rubber In 1907 the production of cultivated rubber had increased to 1000 tons and in another decade to 200 000 tons while the output of wild rubber had remained practically stationary at 40,000 tons a year About 80 per cent of the 700 000 tons of rubber produced annually is now cultivated

In 1916 a leading American rubber company decided to make certain a sufficient supply of crude rubber by starting its cultivation, placing William Vaughan—an authority on rubber cultivation—in charge A 20,000-acre tract in Sumatra was purchased, native labor cleared the virgin jungle, miles of modern railroads were built, proper quarters furnished for the 7500 natives employed on the plantation and today much of this tract has the appearance of a city park

When the car owner sits comfortably in his luxurious car speeding over roads of every character with little inconvenience little does he realize the *many processes to which the rubber in his tires has* been subjected in order to obtain the resiliency and wearing qualities that makes motoring a pleasure

Plantation rubber—or cultivated rubber—is much preferred by the manufacturer for the reason that it arrives in this country in a far superior condition to that of native rubber Difference in freight cost shrinkage and ease of handling are matters of very great importance to him, and wild rubber comes on the market with from 10 to 50 per cent moisture and foreign substance in its composition, while the Far Eastern cultivated product is exceptionally uniform. This uniformity is due to the scientific methods of coagulation and preparation, yet it has as great tensile strength as the finest grades of Para

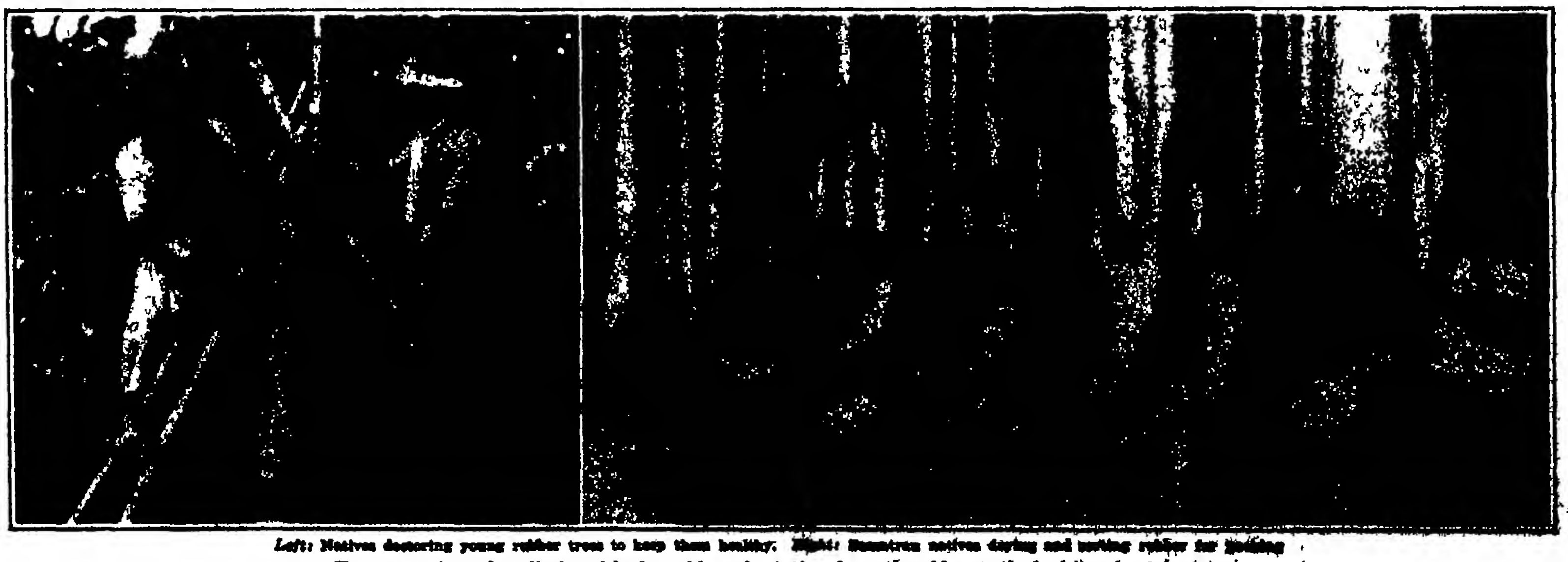
Ordinarily it takes the young rubber tree five years before it begins to bear latex—a thick milky fluid, slightly alkaline, containing three per cent proteids, traces of sugar and mineral salts, about 58 per cent water and 35 per cent rubber

Natives gather the seeds of the rubber tree—which are about the size of the hickory nut—and plant them in nursery beds At the end of six months the seedling has reached a sufficient growth to have the top cut out, a process known as "stumping" This causes several shoots to spring out these grow rapidly, and at the same time the plant becomes hardy enough to withstand the attacks of the white ants

After burning over the ground—clearing it of trees and underbrush—these young trees are planted some 20 feet apart, allowing about 100 trees to the acre *Afterward the ground is carefully kept free of weeds* and grass that the trees may have every particle of nutrition that the soil affords

When the trees are old enough to begin to yield latex, they are ready to be "tapped' Just underneath the outer corky bark lies the layer of cortex cells—a layer some 3/16 of an inch thick and having a slightly pinkish tint it is in this layer that the latex cells are found They run vertically up and down the trees,

(*Continued on page 175*)



Left: Natives doctoring young rubber trees to keep them healthy. *Right:* Sumatran natives drying and sorting rubber for packing

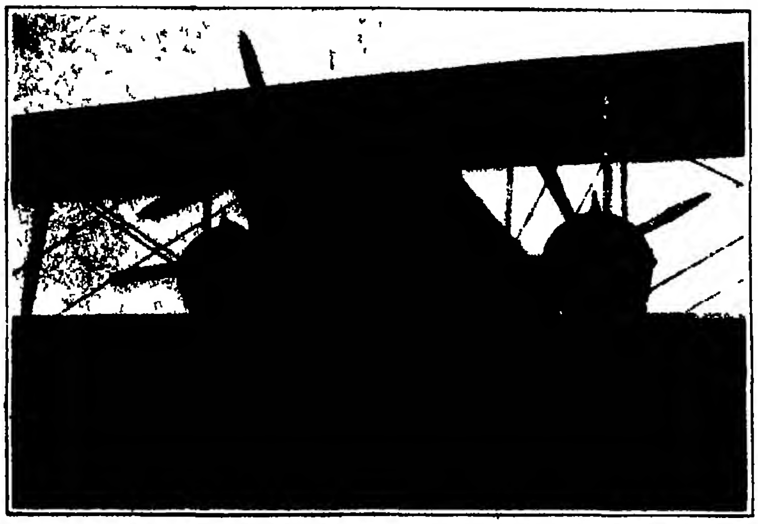
Two operations that distinguish the rubber plantation from the older method of jungle stripping

A Survival of the Fittest Among Airplanes

THE French public, which has ever taken a keen interest in the advancement of aviation, was recently treated to an interesting competition among a number of large passenger airplanes, the object of which was to determine their respective merits for regular passenger service. The main factors of the competition were the maximum of safety, of speed, of general performance, and of dependability over a protracted period of service. First of all, a series of elimination trials was conducted, only the surviving machines being permitted to take part in the final and true test in the form of a flight of 2700 miles. As for surviving machines, only one came through the elimination trials, and that was the new three-motor Farman "Goliath," which is shown in the accompanying illustration.

Under control of the well-known pilot Gonin, the Farman "Goliath" made a remarkable flight It carried a load of over 6000 pounds. The average flying speed over the 2700-mile course was upward of 90 miles per hour, with the motors turning at 1300 revolutions per minute The machine scored a veritably perfect performance, indeed, not even a single wire had to be adjusted upon its return, and the "Goliath" was said to be ready to undertake a new flight without a single repair or tuning up.

It will be recalled that the Farman "Goliath" as a type has been known for the past two and one-half or three years, or shortly after the termination of hostilities However, heretofore this type has had but two motors of 250 horsepower each. The addition of a third engine should make for even greater reliability and greater speed The two-engined Goliaths" have distinguished themselves by the Paris-Dakar flight with seven passengers, Paris-Constantinople, and the regular commercial services between Paris and Brussels and Paris and London



The Farman three-motor "Goliath"—the only machine to survive the rigid French tests for passenger-carrying machines

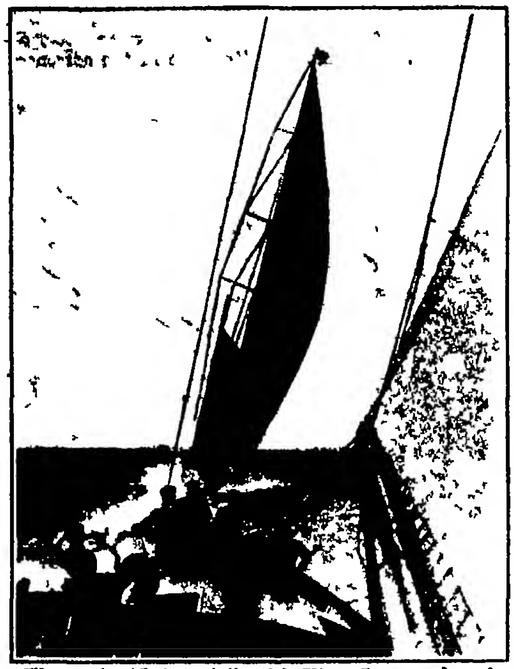
The King's Yacht "Britannia"

THIS photograph of the "Britannia represents something which yachtsmen never expected to see again, namely, King Edward VII's famous yacht "Britannia" once more with her racing canvas spread and sailing a season's races around the British Isles King Edward was an ardent yachtsman and owned several yachts in succession before he ordered George L. Watson to design for him an 85-foot racing cutter The result was the 'Britannia Built in 1893, she was slightly larger, but practically a sister to the "Valkyrie" which contended for the America's Cup against "Vigilant" Her dimensions are waterline, 87 8 feet, beam, 23.06 feet draft, 15 feet, length over all, 121 5 feet. The "Britannia" was a great success from the first. In 1894 she took 38 races in 42 starts, and it was claimed that in her day she had won more races than any other yacht in her class, having taken over 100 first prizes

That was a famous race between her and the American challenger, 'Navahoe," for the Brenton Reef Cup, which had been taken to England by "Genesta" in 1885 It was sailed, under reefed canvas, from The Needles, Isle of Wight, to Cherbourg and back, a distance of 120 miles, and the two craft tore through the seas practically neck and neck for much of the course 'Britannia" won by 2½ seconds in a race which lasted 10 hours 37 minutes and 35 seconds The race was protested and given to "Navahoe" because the mark boat, owing to heavy weather off The Needles, had been shifted inshore

The present King, who is a real sailorman, having served as a midshipman and risen to the rank of Captain while in active service of the Navy, is an ardent yachtsman, and he has put the old "Britannia," now nearly 30 years of age, into commission and is racing her hard in the various regattas around the English coast. The old yacht is winning her share of races and saving her time allowance against the modern 70-footers and 20-meter yachts designed by such men as Nicholson, Fyfe, Mylne and others.

In this picture the King is standing just forward of the wheel Dead astern of the "Britannia" is one of the most modern types of racing cutters, a sloop as we should call it equipped with the "Marconi mast" and rigged with a main sail which is nothing more or less than the old leg-of-mutton sail of one's boyhood days. In this rig the gaff is missing and the leach of the mainsail runs without a break from boom end to masthead Note should be taken of the elaborate system of strutting, characteristic of the Marconi mast In the usual style of mast there is a single pair of spreaders at the masthead but in these boats there are three struts, and because the mast is stayed at such short intervals, it is possible to reduce its diameter and lighten it up considerably



The yacht "Britannia", with King George aboard

Sterilizing Eggs for Storage

BEGINNING in California and moving east, a tendency to sterilize eggs when placing them in cold storage has gathered considerable strength this year The Poultry Producers Association of southern California will use a sterilization process on a large scale for 1920 storage eggs Chicago egg interests it is stated will also adopt sterilization The process entails an extra storage expense, but changing times justify it and a future date when the entire storage egg industry is on a sterilization basis is not improbable

An automatic electric machine is used for sterilization The eggs are immersed for about five seconds in an oil solution heated to 250 degrees Fahr The immersion sterilizes the egg and closes the pores of the shell, but is so rapid that the yolk and white are not affected and remain in the natural condition

The process does not eliminate refrigeration Sterilized eggs are placed in storage like ordinary storage eggs. They come out of storage in better shape, however, and stand long shipping to market better On a quality basis they command a better market price than ordinary storage eggs

The egg trade has known of the sterilization process for several years, but it is only the present season that there has been a definite serious movement to adopt it. There are several interesting reasons, but the principal one is that the egg business "is not as it was." Cold storage preservation of eggs is not perfect, and never has been, any more than many devices and methods in use are Hitherto, however any waste which the process involved was not out of line with general economic conditions The past year or two in the egg trade has changed this

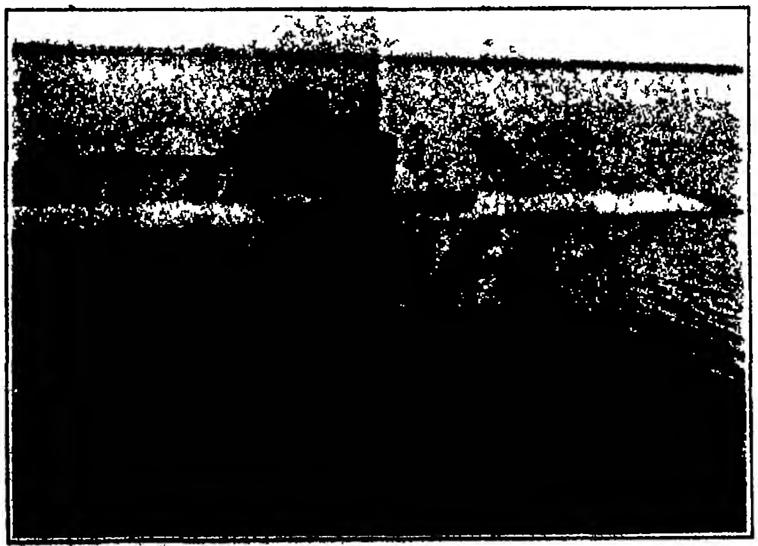
The minimum initial investment in a dozen eggs put into storage has gone up and up—in 1919 the average was about 42 cents -and consequently the necessity for care of those eggs has increased also Notwithstanding the wide popular delusion to the contrary, egg operators over a period of years have anything but a picnic There is ample competition among themselves. It is an authenticated fact that the storage egg interests had a very unpleasant and unprofitable time handling the 1919 egg crop, and one reason was the heavy waste in storage

Spoilage in storage eggs of the 1919 crop was the greatest in years, making an entirely unexpected percentage Various theories in explanation were advanced, the most sensible of which was the class of labor which candled and handled the eggs just prior to storing This labor in 1919 was inefficient, careless, in a degree not before known

There is naturally, following the 1919 experience much greater interest in, and appreciation of safer storage methods. That the Poultry Producers Association of southern California has adopted the new plan is significant

New Flying Boat for the Dutch Navy

MORE and more the European aeronautical constructors have broken away from the conventional lines and developed machines that are truly novel The machine shown in the accompanying illustration is a case in point. Here is a German flying boat built for Holland's naval forces. Note the comfortable, enclosed body at the bow, with the pilot's cockpit above There are ample windows to ensure a clear field of vision Furthermore, note the large deck to the rear of the cabin The motors are placed in a streamlined fuselage above the single plane, and drive a tractor screw and a propeller screw All in all, this design presents a marked departure from the usual flying boat design.



Copyright, Keystone View Co.

German-built flying boat employed by the naval forces of Holland

The Heavens in September, 1921

The Unidentified Celestial Object Observed from Mount Hamilton

By Prof. Henry Norris Russell, Ph.D.

As those words are written, their author is returning from a western trip which has included visits to the four great observatories of the Pacific Coast, and some reminiscences of these suggest themselves.

Next to the memory of the hospitable welcome that is everywhere accorded to the visiting astronomer, nothing stands out more in remembrance than the beauty and variety of the situations. Each one of the four well merits a visit from the traveller, though he have no astronomical knowledge, and even if he does not enter the observatory buildings, provided only that he cares for Nature.

The Lowell Observatory, though the highest of all above the sea (7250 feet) stands on a mesa but a few hundred feet above the town of Flagstaff—an ancient lava flow, long since weathered into soil on the surface and covered with that open forest of splendid yellow pines which is characteristic of the highest sections of the Arizona plateau. But a few miles to the northward, and in full view rise the noble peaks of the San Francisco Mountains, more than a mile above the plain, and mantled with snow until late in the summer. Though their volcanic fires are long extinct, there are smaller craters near their base which cannot be many centuries old, and beyond them, where the plains lie lower, stretches the open desert.

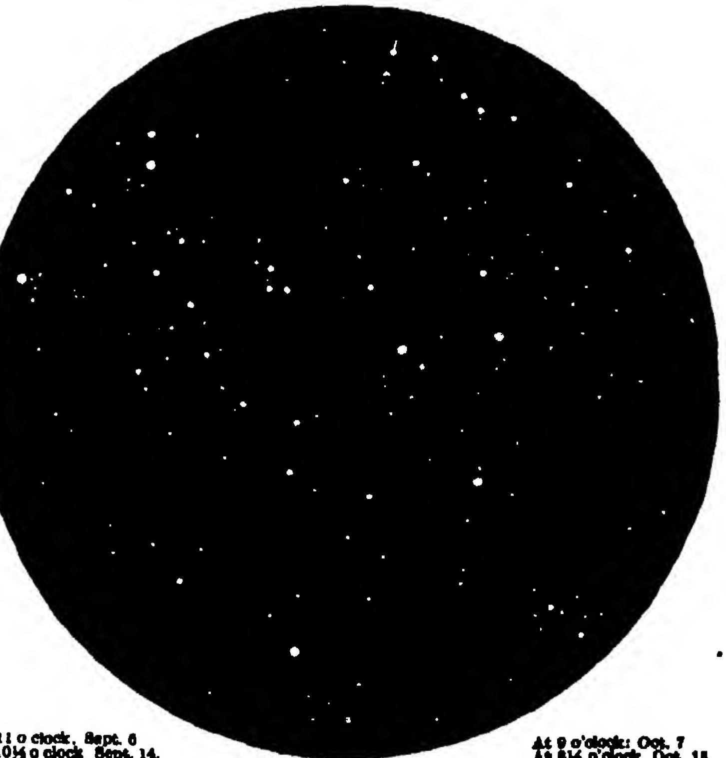
Mount Wilson is indeed a contrast. The Sierra Madre, on whose outer range it lies, is a mass of granite, rising abruptly from the rich plains of the California coast, and intricately dissected by steep-walled canyons. So abrupt are the slopes that it was only with great trouble, and at no light cost that a road wide enough for motor vehicles has been made to the top, and even on this the places where one car may pass another are carefully marked, with notes concerning the distance to the next. Looking southward from the summit the eye ranges over the wide and fertile plain darkened for miles by orange groves, and spangled at night with the countless lights of towns and cities to the shores of the Pacific and, in clear weather, fifty miles out to sea. The mountain top itself is ample, and the various buildings and domes are scattered among the great pines, so that the newcomer, at midnight, must be on his guard lest he get lost.

Mount Hamilton is a narrow ridge, with several peaks nearly of the same height. The Lick Observatory crowns one in the center, and the houses of the inhabitants of that isolated and interesting community—which boasts of far more distinguished men of science per thousand of population than any other place in the world—are strung out along the crests on either side. Unlike the other three observatories this one is not in the woods, the coast range, in this region, is either open grass land, with scattered oak trees, or clad with dense but low and scrubby chaparral growth. In the rainless summers of California, the grassy slopes take on a tawny brown which to the writer's eyes, is not a whit less beautiful than the dark green of forests. The rocks are softer than on the Sierra Madre, and the slopes less extreme, so that the road to the summit is wider, and has easier grades than that which ascends Mount Wilson, and which is enough to make the stoutest motorist quail when he first attempts it. (A mutual friend of Dr. Russell and the Editor, who has driven across the continent repeatedly, repented of his rashness in starting up Mount Wilson, but it was too late. There is no point between base and summit where one can turn, and he had not sufficient nerve to attempt to back down, so he had to go on to the summit.—Editor.) Very little can be seen of the ocean from the Lick Observatory, for it is hidden by the westernmost of the coast ranges, but the view across the foothills to San Francisco Bay and the valley which runs southward from it is of great beauty, especially at sunset, when the air fills with a ruddy violet light of extraordinary tone.

Quite unlike any of the others, and in many ways the most beautiful of all, is the view from the Dominion Observatory at Victoria. Saanich Hill, where it stands, rises but 700 feet above the sea; but it commands a prospect out of proportion to its size. North and west lie the broken and tumbled hills of Vancouver Island, covered with primitive forest and rising to a couple of thousand feet. At their base is a little lake, of the sort which dots the hill country of New England. To the east are the Straits of Georgia—land-locked waters full of hilly islands; and to the south the twenty-mile width of the Straits of Juan de Fuca. Beyond this, in a long serrated line, rise the Olympic Mountains, in the very northwestern corner of the United States, their peaks far above timber line and the highest crowned with permanent snow. Far away in the southeast and east rise the still loftier ice-clad cones of Mount Baker and Mount Rainier.

The Mysterious Visitor

All this description of landscapes may seem to have but the slightest connection with astronomy, but if it had not been for views and sunsets a remarkable observation, which must take its place in the astronomical record of the month, would not have been made.



At 11 o'clock, Sept. 6
At 10½ o'clock, Sept. 14.
At 10 o'clock, Sept. 21
At 9½ o'clock, Sept. 30.
At 9 o'clock: Oct. 7
At 8½ o'clock. Oct. 15.
At 8 o'clock: Oct. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on September 6, etc.

NIGHT SKY: SEPTEMBER AND OCTOBER

A little less than two weeks ago, a group of which the writer was one sat on the porch of Dr. Campbell's house at Mount Hamilton, watching the setting sun. Not all the party were astronomers, two of them, like the host's son Douglas, had returned from France with the hard won title of aces. As the sun slowly disappeared, the astronomical members of the group, trained by long practice to the close observation of a single object in the field of view, were intent upon the singular changes in the apparent form of the setting sun, produced by atmospheric refraction. But the very life of the military aviator depends continually upon his ability to see, at a glance, all that may be in the sky above him, or the air beneath. So it is perhaps natural that both these officers—Captain Rickenbacker and Major Chambers—noticed a bright star, close above the setting sun. The former saw it first, as afterward appeared, but the latter was the first to remark upon its presence.

As soon as attention was called to it, everyone could easily see a brilliant yellowish point of light quite stellar in appearance, just to the left of the place where the sun had vanished, and not more than two degrees above the horizon. Within five minutes it had set, or at least had disappeared into a low-lying bank of haze, but not before Dr Campbell had observed it with binoculars and found it to be still stellar in appearance.

Conversation brought it out that Captain Rickenbacker had seen the object while the sun was still entirely above the horizon, at a distance of about six diameters from the sun. This made it clear that it must have been a celestial object, for it had evidently followed the setting sun downward before it had been lost to sight.

It was obvious at once that this was no common object. To be visible before sunset, at so low an altitude, and in a sky which for that climate was not very clear, the thing must have been a good deal brighter than Venus—and Venus was far away on the opposite side of the sun. A glance at the Ephemeris showed that no other planet was in this region.

What was it, then? A new star? Not likely, for it was far from the Milky Way, where most of the Novae have appeared, and besides, it was brighter than any Nova on record, except perhaps Tycho Brahe's. A comet? This looked more reasonable, for there are a number of instances on record in which comets, at perihelion, close to the sun, have been visible in broad daylight, the last cases being as recent as 1882 and 1910.

An account of the observation was telegraphed to Harvard, the center for the dissemination of such news on this continent, and thence sent broadcast. Careful search at Mount Hamilton the next morning, with field glasses and telescopes, however, revealed nothing, and up till last Monday, eight days later, no further news of the suspected comet had come in.

This does not mean, however, that there was any illusion about the original observation. It is entirely possible for a comet's orbit to be so situated that it may approach the sun from behind, for a terrestrial observer, in such a way that there may be no chance of seeing it upon a dark sky, and so detecting it by the ordinary methods of search. If the comet came from the southern part of the celestial sphere, and had a small perihelion distance it might never be visible to northern observers at all, except in daylight, when close to the sun. It may be recalled that the great comet of 1882 was first seen at Rio de Janeiro, but owing to defective cable communication news did not reach the northern hemisphere until after it had passed perihelion, and been discovered by numerous observers in broad daylight. Again, the daylight comet of 1910 was first seen by workmen on a railway in South Africa, who supposed it to be Halley's Comet, and only the accident that a reporter for a local paper wrote a paragraph about it brought it to the attention of the astronomers of the Transvaal Observatory.

There is reason to hope, therefore, that we may yet receive news from some southern point which may enable us to say more than is at present known concerning this strange visitor to our skies.

The Heavens

Turning to the unchanging stars, and watching the heavens at the hour of observation indicated on our map, we find the Milky Way in a huge arch spanning the heavens. Where it disappears in the southwest is Sagittarius, just setting. Then, above the great star-clouds, Aquila, and almost overhead, the great cross of Cygnus. Beyond this, descending toward the northeast, we reach Cepheus and then Cassiopeia. Perseus comes next, and finally Auriga, which has just risen.

The Great Bear is low in the northern horizon, with the Little Bear and Draco above it. Hercules and Corona Borealis are well down in the west, and Lyra higher up. The southern sky is dull, its only bright stars being Fomalhaut, low in the south, and [illegible]

(Continued on page [illegible])

Our Latest Dreadnought, the "Tennessee"

THE lower photograph of our latest battleship, the "Tennessee," was taken from off her starboard bow, when she was undergoing her full speed trials, recently, off Rockland, Maine. This fine ship, it will be remembered, is driven through electrical reduction gear. In the trial she comfortably achieved her contract speed of 21 knots.

The photograph is of interest as showing, better than any we have seen, the way in which that portion of a modern battleship which has to do with the navigation and the fighting of a ship, has grown up step by step to its present remarkable bulk and height. The freeboard, forward to the level of the forecastle deck must be about 25 feet on this ship, at her mean draft; and if so, the officers at the range-finder on the roof of the pilot house must be about 75 feet above the water. Most of the tall foremast is obscured by this massive superstructure, so that there is a clear view of the mast for not much over 15 feet before we come to another fighting station, or series of fighting stations, which takes the place of the old fighting top. Here we have an enclosed fire-control position for the secondary battery, now known as the torpedo-defense battery, another such station for the fire-control of the main batteries, and above that is a third position, glass-enclosed, which gives an all round view.

It will be noticed that the top of the mainmast carries a duplicate construction to this. The disk on the front of the foremast is for showing the range at which the "Tennessee" is engaged, such information being given for the benefit of other ships in the fighting line.

Another interesting feature revealed by this picture is the great length of the principal range-finders, of which one is carried in each turret, in the angle formed by the roof of the turret and its rear wall. In our latest ships immediately preceding the "Tennessee," these range-finders extended from side wall to side wall, with their object glasses projecting just beyond the turrets. In the "Tennessee," apparently the range-finders have been still further lengthened, and there is a projection of some 8 or 10 feet beyond the turret on each side. Length means accuracy of finding, and with range-finders of the size here shown, provided we are getting the best optical glass, it should be possible to give instantaneous readings of the range to the enemy with a very small percentage of inaccuracy, even at extreme ranges.

Fine ship though the "Tennessee" is, she will be the last of her class, for in the "Maryland" and her three sisters, the twelve 14-inch guns will give place to eight 16-inch. The 16-inch is a vastly more powerful piece, but at the same time the "Tennessee," with her twelve pieces and with equal gunnery would, in competition, put 30 per cent more shells through the target than the "Maryland" with one-third per cent less guns.

Six of the twelve 14-in. 50-caliber guns, which form the main battery of the battleship "Tennessee"

Automatic Barn Cleaning

IT is sometimes erroneously assumed that because labor-saving farm machines and appliances are very numerous the field is getting [illegible] development. A [illegible] job in thousands of [illegible] the dental [illegible] We [illegible] the only removal of manure, a heavy abominated chore. It is true that litter and manure carriers, now installed in many barns, are a decided advance over the wheelbarrow, but the overhead carrier doesn't solve the problem, for even with carriers there is a lot of heavy, time-consuming manure-forking.

The need is for some mechanical arrangement which will eliminate this expensive hand work, automatically removing the manure. The problem is simplified somewhat from the fact that gutters to receive manure are commonly built into the barn floor behind the cows. It would seem a practical matter to develop a device which would clean these gutters mechanically, obviating the hand-forking now required.

As a matter of fact, in a very few isolated cases, ingenious dairy farmers have home made mechanical cleaners now in successful operation at this job. An Ontario man's plan is adapted to his 100-foot barn. Two drums or rollers, one at the inside end of the manure gutter, the other at the outside end, where a manure spreader receives the transported manure operate, in conjunction with a 2 horsepower gasoline engine, a chain and wooden cross-piece arrangement which travels along the manure gutter carrying the manure with it. The wooden cross-pieces are a trifle narrower than the gutter, so that they move smoothly, yet catch all the manure.

As the chain travels outward with the manure, emptying it, the chain winds up on the outside roller. It is allowed to dry well, then by a reversing process which unmeshes one set of gears and meshes the other the roller at the inside end draws the chain and the entire cleaner back into place.

This farmer has successfully cleaned his gutters mechanically for six years. The cost of the equipment, put together out of odds and ends, was very reasonable while for power he already had an engine used for other barn chores.

This farmer thought for years that he possessed the only barn-cleaner in existence—until he heard of another Ontario man who had attacked the same problem solving it in a different way. This second farmer used the chain and cross-piece idea, but had the chain travel like a belt, that is, it passed along the gutter emptied through the barn wall, and returned beneath the gutter, where the barn construction gave it room to move. In both cases there were details that gave trouble at first but the men worked them out. Adoption of similar arrangement in dairy barns the continent over would mean an enormous aggregate saving in labor.

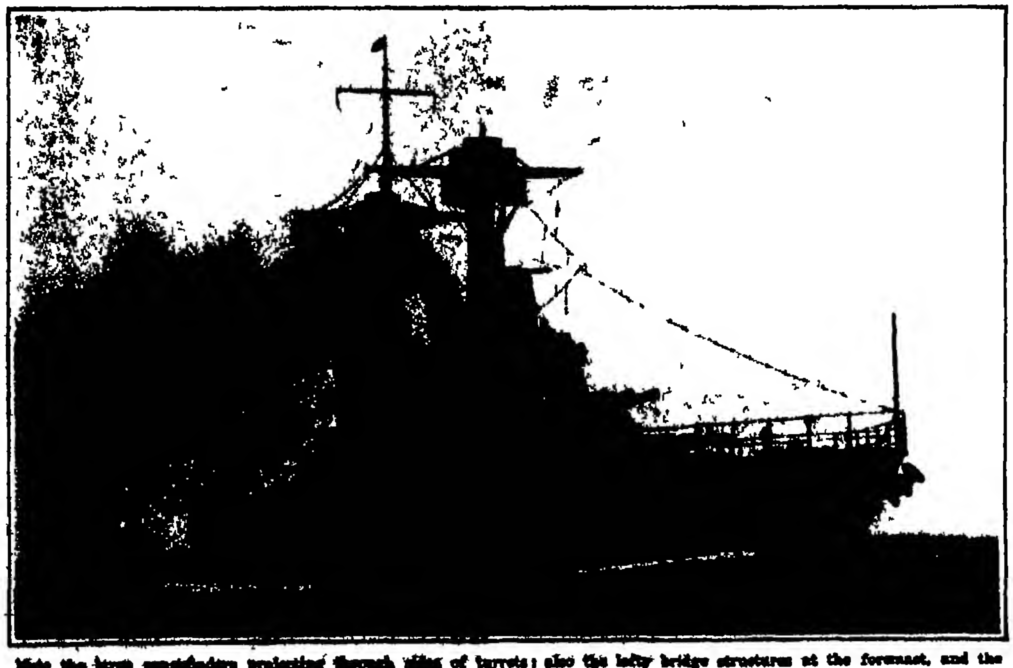
Railroad Steel Tie Plates Rust Less with Copper in Them

THE New York Central lines have conducted a series of tests to determine the relative loss of metal in tie plates of various compositions, including those containing a small percentage of copper. The length of time over which the tests were conducted varied from two years to a maximum of six years, and some of the tests are still in progress. In all cases the maximum corrosion developed on the bottom or under side of the plates, contrary to the generally accepted theory of most engineers and maintenance of way men that the maximum corrosion takes place on the top or exposed portion.

The percentage of copper in the plates containing that metal ranged between 0.25 per cent as a minimum and 0.5 per cent as a maximum, the plates so treated being rolled otherwise, according to the standards of the New York Central. The copper treated plates so obtained were subjected to the same tests as the other plates. An exposed test on a number of steel tie plates rolled from mild Bessemer steel containing 0.25 per cent copper and a number rolled according to the same specifications without the copper content showed an average loss of 8.88 per cent for untreated plates and only 1.46 per cent for the treated plates.

A second exposed test was made which covered a larger number of tie plates rolled from metals of various compositions. The plates used in this instance were cleaned and then exposed on the roof of a building at Hoboken, N. J. where the action of the salt air of New York Bay could be studied. Tests showed loss on the copper plates from 0.46 to 0.72 per cent, averaging 0.56 per cent.

In comparing the data so obtained the nearest approach to the results reported from the copper treated plates was a loss of 0.50 per cent for high carbon open hearth steel, too hard to punch. The pure iron plate came next with 1.17 per cent, and then the high-carbon Bessemer plate, with 1.77 per cent, the latter also being too hard to punch. The remainder, which were standard steel tie plates, varied from 4.70 to 8.00 per cent, showing for common or regularly accepted tie plates 8 to 10 times the loss for the special copper-treated ones.



Note the large rangefinders projecting through sides of turrets; also the lofty bridge structures at the foremast, and the two-deck, enclosed, fire-control stations at top of both masts

Battleship "Tennessee" making 21 knots on her trials

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Revolving cabinet, with telescope, that makes sun baths available in the higher latitudes

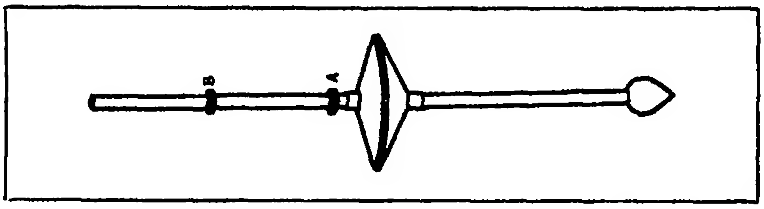
Revolving Sun Baths

THAT the rays of the sun can be used for curing many skin diseases and that the sun baths are advantageous even to those who are in perfect health has long been well known to the general public But how is this most beneficial agency which Nature has placed at our disposal to be utilized in northern countries where the hours of sunshine are few? That is a problem which a Brittany doctor, M J de Thesac, has tackled and, as will be seen from the accompanying photograph successfully solved His invention consists of a most ingenious revolving cabin combined with a telescopic arrangement, bearing a huge lens for concentrating the rays on to any part of a patient's body This installation which has just been tested in the neighborhood of Quimper, enables the sun's movements to be followed with ease Moreover, it is so constructed that the patient having closed the door of the cabin is shielded from inquisitive eyes This most singular looking device has created quite a sensation in French medical circles as well as in the locality of Quimper It is as novel as it is simple

Apparatus for Testing Tar

THE apparatus illustrated affords a *simple and reliable means of testing* the viscosity and consistency of tars according to a British journal Obviously, liquid fuel, to serve its most useful purpose, must be sufficiently fluid to flow by gravitation at normal temperatures. These conditions are readily met by 50 per cent mixtures of pitch and oil, *though it is by no means unusual to* see so-called 50 per cent mixtures which have to be shoveled out of the barrel This is not a question of temperature because as a matter of fact the mixture is not so adversely affected by a comparatively low temperature as is pure tar, as was evidenced in a 50 per cent mixture at the Greenwich Tar Works of the South Metropolitan Gas Company, London England, which at a temperature of 55 degrees Fahrenheit was decidedly more fluid than an average tar at 60 degrees

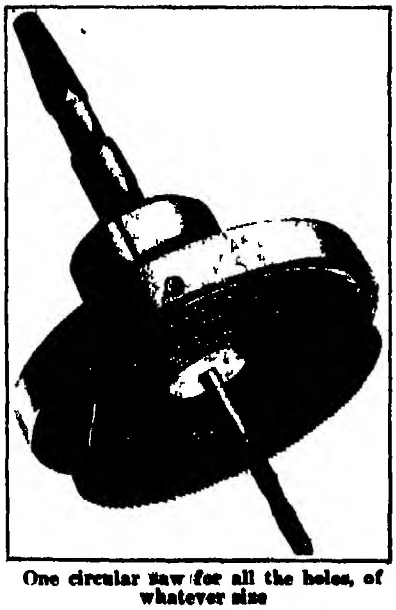
It has been suggested that the standard should be specific gravity rather than percentage of mixture, such a standard, however could not be universally applied owing to the variations in the makes of tar Thus, while the specific gravity might be the same, the actual consistency (the all important factor) might vary considerably The exact percentage of the mixture need not be seriously considered, as the calorific values of the pitch and oil are approximately the same It therefore resolves itself into a question of fluidity, and this may be determined by the instrument under notice. It is first necessary to prepare the mixture of highest consistency which can be profitably employed, and then have it tested by the instrument The test is made in a cylindrical vessel, the material to be tested being at 77 degrees Fahrenheit The instrument is allowed to sink into the mixture, the time occupied in sinking by that portion of the stem between the two rings A and B indicating the properties of the mixture as regards consistency



To test the consistency of tars (the apparatus is shown on its side)

A Handy Circular Saw

THE mechanic who is obliged in the course of his day's work to cut out, from metal blocks or sheets, any considerable number of holes, will testify to the utility of the instrument shown here It was originally designed, we are given to understand, by an automobile repair man who was frequently called upon to put new speedometers and other instruments in old instrument boards. The drill is started at the center of the hole-to-be, and after it gets well into the metal, the saw comes along in its trail and takes hold of its end of the job The hole is cut, of the desired size, in a jiffy A single chuck and blade are sufficient for drilling and sawing holes of a wide variety of size The blade can be placed in any circular groove for desired size.



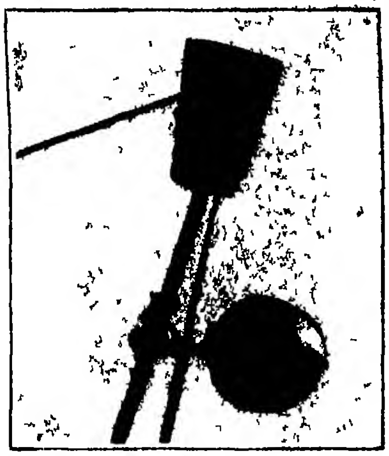
One circular saw for all the holes, of whatever size

An Alarm for the Sleeping Fisherman

LABOR-SAVING devices whereby the fisherman may be relieved of constant watch of the cork as he seeks to ensnare the finny tribe are not uncommon, but the use of an umbrella rib and a sleigh bell as a warning signal of a "catch" is an ingenious contraption *rigged up by a colored man fishing on the* Potomac River, near Washington, D C.

A discarded umbrella rib, to which is attached a sleigh bell, is stuck perpendicularly in the bank When a fish nibbles the bell sounds the alarm and the disciple of Isaak Walton is ready to land the easily beguiled member of the finny tribe The attendant of the hook-and-line can go to sleep on the bank feeling confident that when the sleigh bell tingles there is a perch or catfish on the other end of the line waiting to be landed

A linen line is fastened to the end of the umbrella rib, while the sleigh bell is tied near the top of the rib As the fish nibbles, the rib easily bends and the alarm is given The darky claims for his invention a contribution to the campaign to reduce the cost of living



When the fish nibbles, he rings the bell and the sleeping fisherman wakes

Chicago City Engineer Favors Trailers

LATE reports show that amendments to the traffic ordinance in Chicago have been drafted for submission to the city council with a view to preventing rapid destruction of the street pavements by excessively heavy traffic The proposed changes were discussed at a recent meeting in the office *of the city engineer It is proposed to* change the gross weight of vehicle and load from 40,000 pounds, as at present allowed, to 30,000 pounds, with a maximum weight of 1,000 pounds per inch of tire width, but it was agreed at the meeting that the combination of a truck and semi trailer with load should be allowed a weight of 32,000 pounds, with a limit of 24,000 pounds on any one axle.

United States Patents Abroad

UNDER the Nolan bill, the privilege of our inventors to file applications abroad, covering inventions where the rights of priority had not expired August 1, 1914, ends, September 3rd After that date no valuable patent rights accruing to American inventors during the war can procure foreign protection.

The Paper Suit

SOME time ago, when there was a good deal of excitement about paper suits and the possibility of their putting the woolen trade out of business, a Brooklyn tailor undertook to satisfy himself as to what there was in it. He got hold of some heavy wrapping paper and made him up a suit The material did not look to his practiced eyes suitable for needle and thread, so he used the paste brush The result is the suit *of our picture It was actually worn* about the streets of Brooklyn for a day without calamity of any sort and without attracting very much attention. But it was not a rainy day

However, as we have learned since, this is not the sort of garment that Germany threatened to send over here and sell for sixty cents per suit. From its appearance we do not think that many Americans would have been satisfied with it, even if it was American made The German paper suits are made of *paper yarn that is woven into a coarse* fabric, and come pretty close to our American ideas of cheap but wearable clothes, although too heavy for comfort.

Even though it is of paper and only pasted together, it held for a day

Water Supply of the Panama Canal

(Continued from page 157)

mated that it takes about seven and a half million cubic feet to make a complete lockage This represents the amount of water drawn from Gatun Lake in lifting a vessel 85 feet through the three locks at Gatun and then lowering it down 85 feet to sea level through the locks at Pedro Miguel and Miraflores. Hence it can be figured that the storage of approximately 10 billion cubic feet of water will provide for 1240 lockages. During the entire calendar year 1920 (the amount of traffic was the largest in any previous twelve month period) when over 3000 vessels passed through the canal, the total number of lockages was 2881 The difference in number of ships as compared to lockages is due to the fact that with two ships in a lock chamber at the same time, but one expenditure of water is necessary During the passage of the Pacific Fleet as many as six destroyers lashed together were passed through the locks at one time Experience has shown that with ordinary luck in the arrival of large and small vessels, 24 lockages may be equivalent to 30 ships

Floating, lifting and lowering ships are not the only uses made of water at the Panama Canal More than twice the amount of water required for lockages during the calendar year 1920 was used by the hydroelectric plant located beside the spillway at Gatun, in the generation of electric power for the operation of the locks, the marine shops, dry docks, and other auxiliaries and for lighting the entire Canal Zone It will always take at least twice as much water for the hydroelectric plant as is used for lockages even when the canal is operated at full capacity During the calendar year 1920 the hydroelectric plant used over 44 billion cubic feet of water, which represented 26 per cent of the inflow consumed However, in case of an acute shortage of water there is a steam power plant at Miraflores which burns oil and can be kept at two-thirds the capacity of the hydroelectric plant at Gatun Of course, the production of power at the Miraflores plant is very much more expensive than at Gatun.

The following table shows the consumption of water from the lake during the calendar year 1920, giving the way the water was used, the amount and per cent used in each instance

Water Consumption, Gatun Lake, 1920

Cause	Billion cu. ft.	Per cent of inflow
Spillway waste .	81 00	47
Hydroelectric power	44 42	26
Evaporation	22 40	18
Lockages	20.86	12
Leakages and miscellaneous	2.46	1.8
Increased storage	40	.2
Total . .	171.54	100.0

It is considered that the minimum level for convenient operation of the Panama Canal is to have the lake surface 80 feet above mean sea level, which maintains 40 feet of water in Gaillard Cut However, as about 95 per cent of the ships using the canal draw less than 30 feet of water, there is a wide margin for practical operation Should the water level by any chance drop to a point reducing the depth in the cut to 30 feet only ships drawing in excess of that depth would be prevented from making passage, representing but 5 per cent of the present traffic.

The space between the convenient minimum of 80 feet above sea-level and the maximum storage level of 87 feet, provides almost 32 billion cubic feet of water for consumption during the dry season, the only time when there is any danger of a shortage. It has been calculated that this will provide, along with the consumption of water for the present hydroelectric plant and municipal purposes, enough water to handle 1925 lockages, or approximately sixteen lockages a day for the average dry season. This will care for more than twice the present traffic of the canal, hence it can be seen that there is no imminent danger of the Panama Canal going dry, or the water supply being so reduced as to interfere with the operation of that great highway of commerce However, should the water supply become insufficient two projects for increasing it enough to operate the canal at maximum capacity are now being studied

Our "ZR-2" Airship and Its Shed

(Continued from page 160)

Considerable difficulty was experienced in designing the detail of the crossing of this conduit with the door tracks It was necessary to provide some closure of the slot during the passage of the door trucks because of the shock to so large and heavy a structure by jolting over this opening A plan was perfected so that at each crossing of the rail with the slot a moving rail has been installed which can be thrown by interlocking connecting rods tying together all of the crossing When the doors are not in use, this rail leaves the slot open for the passage of the trolley, guys and line to the airship When the door is about to be moved, the connecting rod is thrown and the rails move up to fill up the slot opening and provide a continuous track for the door

The doors are mounted on standard gage trucks which travel on two lines of track laid on concrete bases They are driven by electric motors with the power transmitted through a plow which collects current from conductors in a slot This slot, or conduit, however, only approaches the outer edge of the door, so as to avoid possible fire risks of an electric conductor near the open door of the hangar In addition to the electric drive, an emergency winch with cables for hand operation is provided to open and close the doors in case the current or motor should fail.

Special attention had to be devoted to the lighting of the hangar because of the possible presence of explosive mixtures due to the escape of hydrogen from the dirigibles. No wires or exposed connections are ever introduced inside the huge shed All lighting is provided through heavy glass gas-proof covers in the walls, floor and roof with the connections outside the structure On account of the gas which is used to fill the balloons, actinic glass is used in the skylights as it cuts out all the detrimental rays Special provisions for working in the hangar are provided by a number of catwalks, or horizontal balconies running along under the roof Fastenings for traveling hoists are provided along the roof rafters

Utilizing Tomato Waste

(Continued from page 161)

Indianapolis, the hub of the middle western tomato pulping industry, the cost is estimated to be $80,000 To assemble the 2500 tons of wet seed alone, the charge would be $16,800 If the seed are shipped to the central plant, they are merely washed, pressed to eliminate excess water, and dried in rotary driers If the entire waste is consigned to the central plant, the seed must be separated and the two lots of seed and skins dried separately

Under the plans of the producer separating the seed from the remainder of the waste at each pulping station, the brevity of the tomato-pulping season (August 1 to October 15) is taken into consideration. The assumption is that the plant will be of only sufficient capacity to dry the peak load, pressing the seed during the winter months. About 2200 tons of dry seed will be accessible Assuming the "union" working day of an expeller as being 8 hours, with a capacity of 500 pounds an hour one expeller will crush 2 tons a day Figuring only 200 working days, and one expeller handling 400 tons, six expellers would be adequate for accomplishing the job An allowance of $9 a ton of raw material is made for drying and handling from the cars to storage bins preparatory to expelling, while $15 a ton of dry seed is reckoned as the cost for extracting the oil and handling from the seed storage to the oil in tanks. Overhead and management charges are included in this computation

Oils extracted by these prescribed methods have been pronounced as of excellent quality Feeding tests with animals have determined the nutritive value of the residue The scientist also determined the value of the Cobwell system of grease recovery from garbage Involving only a single handling, yielding the finished fertilizer and crude oil simultaneously, such a system has the advantage of leaving the plant unencumbered for operation in the manufacture of other products during the remainder of the year Based on a large scale operation of existing plants a charge of $4 75 a ton of raw material is allowed The proceeds from fabricated tomato cyclone waste are computed by Doctor Schroeder to be $110,000 while the expense would be $118,000, rendering the utilization of the whole waste as a foolish undertaking However, if the seed alone are shipped in the profit to be derived from drying and expelling is approximately $54 000 This profit is realized by figuring expelled oil at fourteen cents a pound, solvent oil at thirteen cents a pound, press cake at $40 a ton and dry skins at $10 a ton

The manufacturers of tomato products in the United States might profit by the example of Italy—premier tomato-producing country—in the utilization of seeds and skins The province of Parma uses 83 600 tons of tomatoes annually, this volume yielding from 11,000 to 12,000 tons of skins and seed, containing 80 per cent moisture. Upon removal of the water there is a residue of between 3000 and 4000 tons, of which about two-thirds is seeds The possibility of recovering 500 tons of oil from waste seeds is not a far fetched supposition when it is stated that these seeds when extracted by pressure yield 18 per cent of oil and by solvents 20 per cent Tomato-seed oil has a heating value on a parity with that of olive oil, and because of its drying properties is useful in soap making

Various methods of extracting the oil from the seeds are in vogue in Italy One chemist suggests a way of divorcing the seeds from the skins by agitating the material with water and permitting it to settle, the seed descending to the bottom

Experiments conducted by the Office of Home Economics, U S Department of Agriculture, indicate that the digestibility of tomato-seed oil compares quite favorably with that of olive, almond, peanut, cocoanut, walnut and brazil nut oils When refined the tomato product can be used for culinary purposes, proving satisfactory as a salad oil Tests showed that 16 days elapsed before the oil assumed a soft and sticky film, the experiments being conducted to ascertain its drying properties. The process could doubtless be hastened by the addition of driers to the oil, anyway, the scientists are inclined to attach certain merit to the oil as an ingredient of paints and varnishes

The residue after extracting the oil from the seed is classified as tomato-seed meal, ranking in protein content with cotton seed meal, sunflower seedcake, sesame oil cake, rape seedcake and linseed meal With respect to moisture and ash content the product obtains a rank alongside other feedstuffs. Italy has likewise established the worth of the meal as a feed for cattle, a factory being in operation near Naples for the industrial manufacture of tomato seedcake. Feeding trials are convincing that tomato seedcake is of equal food value to linseed cake in the maintenance of milk cows. Similar investigations of comparing tomato seedcake with flaxseed cake gave the edge to the former as being richer in protein and fat

Complete utilization of the vast accumulation of tomato seeds in the United States in producing oil would also yield a by product of 1200 tons of meal Also supplementary to this volume of meal there would be available 1800 tons of tomato skins Duplicate the example of Italy—incorporating the dried skins with the meal—and you have enhanced the total volume to approximately 3000 tons

Fortunately, the accumulation of tomato waste is concentrated in Indiana, Iowa, Michigan, and Ohio in the Middle West and New Jersey, Pennsylvania, New York Delaware, and Maryland in the East—a condition that logically invites the location of a reducing plant in each of the two principal sections This would facilitate the assembling of the crude material at a minimum expense, while a co-operative plan of manufacture would doubtless give a stable foundation to the industry

The Motor Clipper

(Continued from page 162)

the big France of 7000 tons, built in 1912 and considered the largest auxiliary vessel afloat. Her entire twin screw machinery has been taken away, because it was much too expensive and spoilt the speed of the ship under sail This is a most significant fact 'France is a square rigged ship, which of course made the matter still worse but even a twin-screw schooner is not much better off

Some shipowners now go so far as to do away with machinery entirely for the propulsion of sailing ships, and for their handling as well Of course if no reduction in the number of crew is allowed there is no object in installing costly deck and rigging machinery in the form of winches, etc For propulsion, at present, one has the choice of the common single screw (two-bladed of course) hydraulic propulsion and the aerial propeller The last is of course ideal for propulsion of a sailing ship in calms, and as a 12 foot screw can easily absorb 100 horsepower, with an aerial motor installed on deck, this might be the ultimate solution of the problem Only actual experience can show which is the best But because the sailing ship is helpless in calms, and calms cost money, some kind of 'all work" propulsive machinery must be used where the entire outfit, or a part of it, can be used for every purpose on board requiring power The many different auxiliaries to the main engines now used on motor ships, not only cost a good deal of money but being little used, are sure to be neglected, and can certainly be left out in a sailing ship Only thus can power be made to pay nowadays. And it is surprising how little power is needed to move a big ship at 5-6 knots

As already stated a successful sailing ship must also have an easy form of hull and great stability two qualities that are contrary to each other In sailing yachts this is evaded by using a deep ballast keel below the hull, the keel serving the double purpose of leeway stopper and stabilizer In the 'Motor Clipper' artificial stability is secured by automatic ballast tanks, which empty to leeward and are kept full to windward as required but in heavy winds only The very simple means used cannot yet be disclosed (patents pending) and except in tacking very little if any pumping is required nevertheless, the stability of the vessel is more than doubled

As regards the form of the hull, in the "Motor Clipper' full advantage is taken of the writer's discovery of the natural shape of the water hollow in closing behind a vessel Although the bow wave cannot be overcome and does show in the photograph of the model, the entire absence of a visible wake proves that the

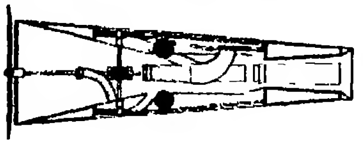
(Continued on page 173)

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AIRPLANE.—G C OFFEN, Box 752 Moose Jaw Saskatchewan Canada An object of the invention is to provide means for facilitating the propulsion of airships of any type and at the same time conserve the motor fluid A further object is to provide means for utilizing the movement of the air to induce a suction or partial vacuum to assist or transmit motion to the propelling means the air current passing rearwardly to the propeller of the machine



A PLAN SECTION

Pertaining to Apparel

UNION GARMENT —L T DWYER Fairfield, Ill The invention relates to apparel for boys and girls its object is to provide an undergarment arranged to give the user the desired freedom in movement of body without danger of unduly straining or tearing the garment. Another object is to prevent the user's body from being exposed at the usual side openings while the garment is worn

SOFT COLLAR HOLDER —J O CONNOR, 437 W 43rd St New York, N Y The present invention is in part a specific form of the invention forming the subject matter of United States Patent No 1369703, granted to the same inventor February 22 1921 the present invention includes a novel means for adjusting the relation of the upper and lower sections of a two-part collar holder

GARTER.—LILLIAN G WARREN Box 35, Westwood, Cal. The invention relates to a garter arranged to hold the hose securely in place without danger of unduly binding on the user's leg or interfering with the blood circulation Another object is to provide convenient means for safely storing money jewelry or other articles the device may be quickly placed in position or removed from the leg

GARMENT —ANNE C BERRY 35 Rowan St Winfield L I N Y The object of the invention is to provide an outer or undergarment having legs, such as rompers bloomers, drawers, combination chemise and drawers and the like whereby the desired comfort to the wearer is insured and the wearer can readily exercise the lower limbs in walking running or jumping without being unduly hindered

Electrical Devices

PORTABLE ELECTRIC SAW — D C LANGE 700 W Atlantic Ave Audubon N Y An object of the invention is to provide a light portable electric saw suitable for use when actuated by an electric current with a great saving of time and labor in that an operator may carry it by hand from place to place and use it as readily and as accurately as a band saw in performing different grades of work more rapidly and with less physical exertion movable guard members are provided to preclude danger to the operator

BATTERY JAR —O WITTMANN 207 S 11th St, Lincoln, Neb The invention relates to battery jars used in connection with automotive vehicles, wherein the plates, and often the cells, themselves, become cracked due to the excessive vibration An object of the invention is to provide a battery jar particularly adapted for use in connection with automotive vehicles or other adaptations in which it is submitted to extreme vibration

HOLDER FOR INCANDESCENT LIGHTS.—W A RAYMOND, South Bend, Wash This invention relates to holders for incandescent lights adapted to be used in locomotive headlights, for instance in place of a carbon ejector so that the light will be supported at the focus of the reflector With this device no change is required in the construction of the headlight, and it is not necessary to interfere with the reflector nor its mounting

Of Interest to Farmers

TRACTOR ATTACHMENT.—J F SCHURLE, address W B. Paton, Cashmere, Wash The invention particularly relates to an attachment for tractors which are adapted to pull plows, ditch diggers, cultivators, etc An object is to provide a means for lifting the plow or digger off the ground when they are not in use, and to provide hand-operative means on the tractor for controlling the position of the plow

Of General Interest

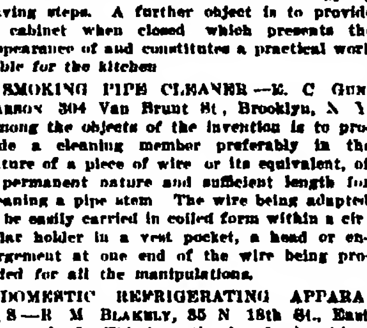
CABINET—LILLIE C DIMICK, 1656 Howell St, Fort Wayne Ind The invention relates more particularly to a combination cabinet including an ironing table, pressing board, and clothes rack the object being to place all of the needed assistance in ironing immediately at hand and eliminate all waste energy by saving steps. A further object is to provide a cabinet when closed which presents the appearance of and constitutes a practical work table for the kitchen

SMOKING PIPE CLEANER —E. C GUNNARSON 304 Van Brunt St, Brooklyn, N Y Among the objects of the invention is to provide a cleaning member preferably in the nature of a piece of wire or its equivalent, of a permanent nature and sufficient length for cleaning a pipe stem The wire being adapted to be easily carried in coiled form within a circular holder in a vest pocket, a head or enlargement at one end of the wire being provided for all the manipulations.

DOMESTIC REFRIGERATING APPARATUS —R M BLAKELY, 85 N 18th St., East Orange N J This invention has for its object to provide a simple compact and efficient arrangement which is particularly adaptable for apparatus of small capacity Another object is to provide a refrigerating apparatus in which moist air is utilized as a cooling medium for condensing the vapors of the refrigerating medium

COLLAPSIBLE CRATE OR PACKING CASE —C F RAINSFORD, 28 Fullarton Rd Parkside South Australia Australia. The invention has been designed for packing, shipping and transporting goods, being so constructed that when empty it can be collapsed or folded down into a small space thereby reducing the space required and consequent cost and the liability to breakage When erected the parts interlock and hold one another firm

STATIONARY —A CALCANO, La Guaira, Venezuela This invention relates to a device which does away with separate envelopes and letterheads, and has for its object to provide a combined envelope and inclosure formed from a single blank having lines of partial separation and lines of adhesive for permitting the sheet to be folded into a letter and an envelop for the letter



SHOWING PLAN AND FOLDED VIEWS

MASSAGE DEVICE.—J O LINDER, c/o St Joseph's Sanitarium, Albuquerque, N M. An object of the invention is to provide a massage device which is hollow and which may contain a heating or cooling agent to give to the surfaces of the massage device the desired temperature A further object is to provide a shape of device which facilitates various massaging operations.

TRAP —H W JUSTUS, Napanoch, N Y. An object of the invention is to provide a construction of trap automatically controlled by a float in the trap and adapted to force the water to a tank at a higher elevation or return the same to the boiler A further object is to provide an arrangement of diaphragm and means operated thereby for controlling the flow of water from the trap through the medium of live steam admitted to the trap to exert a pressure on the water

PROCESS FOR THE PRODUCTION OF A CRYSTALLIZED ESTER OF THE STEARORICINATE-DUODID —F BOEDECKER, Brits, near Berlin Prussia, Germany This process for the production of a crystalline ester is characterized in that first iodin in the presence of aqueous acetic acid is added to the stearoricinate and the latter then transferred to the ethyl-ester

FOLDING BED.—J I HIGGINS, East Rockaway L I N Y The present invention relates to a folding bed of the mantel type which is arranged to be raised to a vertical position against a wall so as to occupy a minimum amount of floor space, and also to provide a shelf for supporting ornamental or other articles.

HEAD FRAME FOR SUPPORTING EYEGLASSES.—F W HAVILAND, 540 Manhattan Ave New York, N Y An object of this invention is to provide frames for eyeglasses in which the weight of the glasses will be taken from the bridge of the nose and supported by other parts of the head such as the forehead or cheeks. The device comprises an adjustable frame for supporting the lenses, and means for supporting the glasses from the head.

UMBRELLA COVER.—I H WEINBERG and C F BIRNING, 28 E 21st St, New York, N Y It is the purpose of this invention to so construct a cover as to permit of a certain amount of stretching so that the cover can be easily drawn over a rolled umbrella and will snugly fit around the same to provide a neat and ornamental addition and one which will prevent injury to the threads of the umbrella.

VANITY BOX —A VERICEL, 315 W 136th St, New York, N Y The invention relates more particularly to that type of toilet case adapted to be carried in hand bags, satchels or the like The primary object is to provide a device of this character in which powder receptacles are employed, the puffs by which the powders are applied serving as a means for retaining the powders in place within the receptacles.

CUP —R JENNINGS La Grange Mo An object of the invention is to provide a device adapted to hold a liquid so that a person may drink therefrom while in a reclining or recumbent position without inconvenience or without spilling the liquid A further object is to provide a device that has means operable to prevent the flow of a liquid therefrom.

SELF-SERVICE STORE —A. W B. JOHNSON, address R L. Johnston, Am Trust Bldg., Birmingham Ala The invention has for its object to provide a self serving store with a plurality of compartments for the display and sale of separate lines of stock, the compartments having corner, wrapping, checking and paying stations so that the clerk on duty may be in close proximity to the customers, at the same time watch the entrances and exits.

STADIA ROD.—E. H SCHWIER, Box 283, Huntington N Y This invention relates to surveying instruments and has reference to a stadia rod provided with graduations consisting of unit measuring figures, each of which is placed at an angle to the axis of said rod An object is to provide a form of graduation for a stadia rod which will be simple and free from complications tending to confuse or delay the transit man.

RUG —E. HEIDENHEIM, 43 Leonard St., c/o Pioneer Rug Co., New York, N Y It is an object of the invention to provide a method for the production of rugs which will enable the weaver to make a rug from a single strand or braid of material, and enable him to change the color of the rug to produce a finally completed article having alternate bands or rings of colors to produce a rug of pleasing appearance.

FAN OR BLOWER.—E. L. GARFIELD, c/o Monson Cooling System Co., 70 W 45th St., New York, N Y The general object of the invention is to provide a fan or blower with a view to promote facility in making and assembling of the structural elements entering into the fan and its frame as well as to promote convenience in the installation of the fan in a ventilating system, and to provide a fan which is durable and made up of simple parts.

SUBMARINE MINE.—T J. CAHILL, [illegible] N 12th St., Philadelphia, Pa. This invention relates to submarine contact mines. The object is to provide for the preliminary handling of a submarine mine up to the time when the mine is submerged, and it is intended to provide against premature explosion during the operation of handling and transporting the mine, by covering the automatic igniting devices with a rigid metal protection.

PICTURE FRAME.—I. STARR, 2015 Mapes Ave., Bronx, New York, N Y. An object of this invention is to provide a frame which includes a pair of transparent faces adapted to expose both sides of a sheet located between them. A further object is to provide a frame having a hinged or detachable member at one side which may be removed to permit the entrance or withdrawal of a picture.

MOISTURE-PREVENTING COMPOSITION.—W H. BEABANT, 727 N 9th St., Sheboygan, Wis. The invention particularly relates to a composition for the treatment of locomotive cab windows, wind shields and the like which are subjected to the elements, the aim is to provide a composition whereby rain and other moisture is caused to flow in a thin even sheet in such manner as not to obstruct a clear vision The composition consists of tobacco water combined with sugar and paraffin It may be readily applied to the surface to be treated

COMB.—J P CANNAVERI, 509 4th St., Port Arthur, Texas. The object of this invention is to provide a comb especially adapted to be utilized to effect the straightening of extremely kinky hair whereby the hair after undergoing treatment of the comb is straightened and is rendered of such quality that it may be dressed and fixed as desired.

MAP —C R. ANDERSON, 1314 Race St., Philadelphia, Pa. The invention more particularly relates to an intensified map especially adapted for educational purposes. The object is to provide a map which illustrates the topographic and geographic features of the subject of the map, which in the instance of the United States illustrates clearly the boundaries of the States and of the counties thereof, and affords means by which the proportionate size of the States and counties and other countries of the world may be illustrated.

BOX BED SPRING CONSTRUCTION.—R. LAVINE, 205 Covert St, Brooklyn, N Y An object of the invention is to provide a simple compact box spring frame which is insect proof An object is to provide a frame having a cover fabric or other suitable material the ends of which are turned over the edges of the bottom of the frame and clamped between the edges and a closure portion.

COMBINED MATCH AND TOOTHPICK.—M BERCOVICI, Calea Nationala 213, Botosani, Romania. The invention relates to an arrangement for carrying matches and toothpicks in a wrapper such as are used for pocket matches, the arrangement comprises two overlying and connecting portions, each portion having a plurality of separable members, both ends of which are free, one end being pointed and the other provided with an igniting substance.

CAMERA ATTACHMENT —W C. MASON, 419 W 115th St., New York, N Y The invention has for its object to provide an attachment by means of which the camera may be focused in the ordinary way, and the operator may be included in the picture, an arrangement of clock work setting off the shutter exposing the film or plate at a predetermined number of seconds. The attachment may be adapted to a number of different makes of cameras.

SHIPPING TAG ENVELOPE.—C. P. KLEMRAUER, c/o Cohoes Envelop Co., Cohoes, N. Y Among the objects which the invention has in view are to provide means for reinforcing the portion of an envelop to which is attached the devices whereby the envelop is secured to the article shipped, to facilitate the introduction of the tying device, and to simplify the general construction.

CLASP ENVELOP.—C. P. KLEMRAUER, c/o Cohoes Envelop Co., Cohoes, N. Y. This invention has for its object to provide an attachment for locking the closure flap of an envelop constructed from material similar to the body thereof, and arranged to increase the resistance to any [illegible] [illegible] in proportion as the [illegible] is [illegible].

RUDDER LOCK.—F. R. [illegible], [illegible] Chestnut St., Allentown, N. J. [illegible]

The Motor Clipper

(Continued from page 171)

model is experiencing the minimum resistance obtainable.

We now come to the sails of the "Motor Clipper. In the otherwise excellent picture in the April 23rd issue the artist has made a striking mistake in leaving the upper gaffs standing whereas in practice these gaffs are always lowered, the throat standing and with the sail secured to the after side of the masts. Thus nothing is left dangling above the lower gaffs, and these are kept steady by the wind pressure. Otherwise the shortening of the sails is correctly shown in the picture with only the lower courses, as shown here the vessel is fit for almost anything in the way of gales at sea.

The spars of the lower sails are used as cargo booms as shown in the illustration being set off on derrick table and cross trees to give more swing' to the cargo, specially in five and six masted schooners with short spars. The lower sails are stowed and thus there is no obstruction to working the cargo and the costly lower sails are saved.

The sails on each mast are identical which means the smallest number and cost of reserve sails and spars. When one reads of a big new five-mast barque receiving a complete double suit of sails from the builders (82 sails in all) one might stare indeed at such waste in the present economic crisis. Certainly cheap ocean carriage is not fostered by such extravagance. Let us not forget that cheap freight rates concern not only the shipowners but industry and farming and all civilisation.

In view of the overwhelming evidence in favor of the *efficient* sailing ship it is indeed funny to hear the reasons urged by some steam shipowners against the sailing ship. They are the very reasons that, in 1865 were used *against* the steamer and *for* the sailing vessel. Conservatism always finds a seemingly plausible reason for keeping in the old rut but necessity is a hard master. The shipowner who survives in 1930 will own and operate only vessels that, on the smallest possible capital outlay (first cost interest depreciation etc.) involve the smallest operating expenses and can carry cargo for the cheapest freight rates, independently of coal strikes fuel shortage wind and weather.

Such a vessel I believe is the 'Motor Clipper' of 5000 tons D W big enough for profitable working small enough to get cargo anywhere.

Transmitting Photographs and Drawings by Radio

(Continued from page 168)

mechanical electrical and other troubles must arise. The main difficulty is to reduce the lag as much as possible so that one impulse will not be piled atop the preceding one.

Facsimile handwriting and printed matter have been transmitted by radio to the French receiving station. In fact it is believed that the greatest application of M. Belin's remarkable system will perhaps be in the direction of greater accuracy, and the facsimile transmission of messages. Column after column of newspaper print or typewritten matter can be transmitted by wire or wireless and received without a single deviation from the original. Furthermore because of the high speed of this transmission it will greatly increase the traffic over our present systems of communication.

Industrial Alcohol

(Continued from page 164)

In [illegible], where cheap water [illegible] is available, it is said that special [illegible] have been erected for [illegible] carbide. The [illegible] in the regular way in the electric furnace and is then converted into acetylene by means of the action of water. Alcohol may be produced from the acetylene in two or three ways by catalytic action.

In England alcohol has been successfully produced from ethylene obtained from coal and coke oven gases. The report of a committee to the British Parliament recently emphasized the importance of this step. This statement was made.

The amount of ethylene in the gas works and coke ovens of Great Britain is estimated to be sufficient to yield annually up to 150 000 000 gallons of 90 per cent alcohol which the *Times* declared the makers could afford to sell for 15.3d (30 cents) a gallon.

Another possibility which makes an appeal to popular fancy and which will no doubt be revived from time to time is the use of small stills in which the farmer could utilize his waste products in making his own motor fuel. In fact this practise is not at all uncommon in Germany. But according to B R Tunison a trade authority there is little hope that this source will ever effect the market in this country.

There are several reasons says Mr Tunison why this is not likely to take place. Labor is very much higher in this country than in Germany. The farmers of this country have become accustomed to production on an extensive scale rather than in an intensive manner and are not likely to be satisfied with the results of a small distillery. In order to obtain satisfactory results the fermentation must be carefully controlled and the average farmer does not possess sufficient technical training to do this effectively. The manipulation of the alcohol plant is difficult except to the technical man. These farm plants would necessarily be small units because of the limited amount of raw material available the cost of the installation would be high the labor cost would be excessive the output would be small and the unit cost of production would be so high that the farmer could buy alcohol cheaper than he could make it. Our case is quite different from that of Germany where these conditions do not exist and where the industry has been subsidized by the government. Without such subsidy and the government pressure it is my opinion that the farmers of this country are not likely to produce alcohol for commercial purposes for some time.

There is one other possibility for cheap alcohol which deserves more than passing attention at this time. This is the chance that we will find in the tropics some plant or plants rich in starch or sugars which could be used for making alcohol but which is not used as a food.

The nipa palm for instance may serve as a source for industrial alcohol. It is said there are over 100 000 acres of nipa swamp in the Philippines of which about 90 per cent has never been touched and it is estimated that this untouched swamp area could be made to yield 50 million gallons of alcohol every season. Various specimens of the agave and cactus are used in Mexico and the southwestern part of the United States in making alcoholic drinks and it is considered possible that some day these plants may be an important source of industrial alcohol. There are many other tropical plants which may be used but the expense of transporting them to existing alcohol plants the difficulties of establishing new plants in the tropics and the great distance from the markets all argue against any revolutionary development in this direction.

It will thus be seen that the situation is a very complex one and that the problem of cheap alcohol is being attacked by many minds from many angles. The materials which can be used for the commercial production of alcohol already are a formidable list and to these are constantly being added others.

(Continued on page 175)

RECENTLY PATENTED INVENTIONS

(*Continued from page 172*)

which shall be incapable of becoming loosened during the progress of the vessel.

LEDGER TRAY.—J. E. BEMIS, c/o Rude Auto Co., Marshalltown, Iowa. Among the objects of this invention is to provide a device for holding data cards or the like which is extensible longitudinally and laterally whereby varying numbers of cards may be accommodated and selected cards may be partly withdrawn laterally for reference without removing the same from the order in which they are placed.

SPIRAL GUIDE FIRE ESCAPE.—A. W. BUTTERFIELD, 7512 58th St., S.E., Portland, Ore. An object of the invention is to provide a portable fire escape comprising a cable adapted to be securely anchored to a window casement sash or the like and a hand grip adapted to receive the cable in such a manner that the rate of movement is retarded, moving slowly downward when a load is suspended therefrom. The device is small and light and may be carried in a traveling bag or the like.

DISPENSING CAN.—F. J. LACINA, address A. Dudek, c/o Farmers State Bank, Clarkson, Neb. This invention has for its object to provide a can which may be held in any position convenient to the user and yet dispense its contents without difficulty. A further object is to provide means whereby oil will be prevented from flowing from the can when it is unintentionally inverted, means are also provided whereby oil may be drawn from the can until it is practically empty.

FUEL IGNITER.—C. J. VLASAK, 3340 S. Compton Ave., St. Louis, Mo. The invention relates more particularly to devices for igniting fuel in stoves, furnaces, grates, and the like without the necessity of kindling or paper, the prime object being the provision of an inexpensive and readily adjustable device of this nature adaptable to convenient support and capable of easy manipulation.

BOW FACING OAR.—J. L. KEMP, 266 S. Meeting St., Charleston, S. C. The primary object of the invention is to provide an adjustably mounted oar which may be operated from a sitting or standing position in a row boat or similar craft. The device may be moved to any position along the side of a boat and is provided with means for operating the oar while facing the direction of travel, also means to regulate the forward or backward sweep.

AUTOMATIC FLUSH.—J. B. WARBS, 4506 S. 32nd St., Omaha, Neb. The invention relates to flushing devices particularly for use in connection with toilets of any kind and has for its object to provide a flush which is so constructed that the reservoir tank will be emptied at predetermined intervals whereby the toilets may be kept in a thoroughly sanitary condition.

HUMIDIFIER.—L. G. HOLTSCHNEIDER, 15 Maple Terrace, Charleston, W. Va. Among the objects of this invention is to provide a device which will occupy the space of a cigar in a box of cigars and which can be adjusted to give just the desired moisture or to shut it off entirely. A further object is to provide a humidifier which has an inner absorbent core spaced from the walls of the casing so as to permit of a relatively large evaporating area around the core.

HAT STRETCHER AND SHAPER.—D. FRANKLIN, 1250 Fulton St., Brooklyn, N. Y. The special object is to provide a hat stretcher and shaper designed to permit the salesman in a retail store to readily shape a hat so as to accurately fit the customer's head and to accommodate bumps or other irregularities of the head. Another object is to permit of readily ironing or steaming the base portion of the hat crown.

TRANSPLANTING RECEPTACLE.—L. WEIL, Goldsboro, N. C. This device relates to the transplanting of large evergreens, shrubs, and more particularly trees with the roots and earth or "ball" as it is termed, around them. This transporting and transplanting receptacle includes a pair of side walls which are lowered into the ground around the root ball and hingedly secured together, means are provided with the walls, adjacent their lower edges for supporting the earth within the receptacle thus preventing to a greater extent jars loosening the earth around the roots.

UMBRELLA HANDLE.—R. KAMENETZKY, 32 Union Sq., New York, N. Y. An object of the invention is to provide an umbrella which is hollow and contains a pair of cords so that the hand may be slipped between the cords and the handle suspended therefrom, or the cords may be placed in the handle out of sight when it is not desirable to use them. Another object is to provide a coin purse on the knob which holds the cords.

IRONING BOARD.—A. MINTZ, 260 Delancy St., New York, N. Y. The primary object of the invention is to provide an ironing board support so constructed as to permit use of the board with garments of all types, at the same time provide ample room beneath the board to receive that portion of the clothes not operated upon. A further object is to provide a board which may be turned end for end and which will be locked against movement.

ROOF DOOR.—P. HOGSTROM, 952 10th Ave., Long Island City, N. Y. An object of this invention is to provide a roof door that will automatically open under a predetermined heat. A further object is to utilize the weight of the door and cause it to gravitationally swing to the open position and to normally restrain the door in closed position subject to a fusible element, also to provide for manual raising and lowering the door without affecting the automatic control.

COTTER PIN.—H. R. FRANCIS, 218 E. 5th St., Los Angeles, Cal. This invention relates to a cotter pin composed of two independent separable interlocking members. An object is to provide a cotter pin in which the two members are precisely alike but are reversely positioned, and insure a perfect lock holding the part together against vibration, at the same time being readily assembled or taken apart without tools.

Hardware and Tools

COMPOSING STICK.—C. B. WRIGHT, 2787 Boulevard, Jersey City, N. J. An object of the invention is to provide a composing stick arranged to enable the compositor to correctly set the type in case a stereotype or other insert is to be used in conjunction with the said type and without requiring such stereotype for the insert on the stick; the user may open the filled stick for removal of set-up type of any part thereof.

BORING AND THREADING TOOL.—D. D. WELLS, Genl. Delivery, Wynona, Okla. Among the objects of the invention are to provide an internal spring boring and threading tool which when used for instance in cutting screw threads or in finishing smooth bores, will enable a smooth and even surface to be produced with the minimum of skill on the part of the operator; also to provide a tool that will enable heavy or rough cuts to be taken without danger of the tool breaking.

MASSAGE TOOL.—H. MALM, 207 5th Ave., New York, N. Y. This invention relates to toilet devices, and more particularly to devices designed for massaging the face and scalp. It is the primary object to provide a combination device which is capable of attachment to the hand of the operator in such manner that either device may be used.

TOOL HOLDER.—B. T. CARSON, c/o Kinderhook Knitting Co., Kinderhook, N. Y. The principal object of the invention is to simplify the means for associating a tool with a tool-supporting shank which means is adjustable and eliminates the use of fastening devices such as screws or bolts, the device when adjusted will rigidly clamp the tool in such manner that it will not become disarranged from its set position.

MULTIPLE SUCKER ROD SOCKET.—A. H. NEILSON, 417 E. 1st St., Tulsa, Okla. Among the objects is to provide a socket having grippers or slips with the teeth on the inside disposed on a continuous taper from the entrance to the upper end, so as to grip any size of object within the compass of the socket, regardless of whether that object is the round, square or irregularly shaped part of a sucker rod or the like.

FOLDABLE HACKSAW.—L. D. BARNES, Kountze, Texas. A purpose of the invention is to provide a folding hacksaw which in its extended position functions as effectively as a saw of rigid construction, at the same time being foldable to occupy the minimum amount of space so that it may be carried in the pocket.

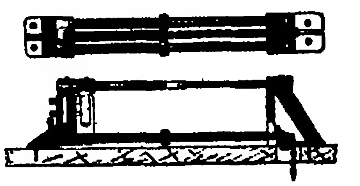
WEDGE.—A. T. JESPERSEN, 5116 Walnut St., Omaha, Neb. This wedge is more particularly adapted for the splitting of logs, a purpose being to provide a wedge of this character which is of simple and efficient construction and which is capable of effecting a greater degree of splitting than wedges of general use. The wedge comprises a main section and an auxiliary section.

PIPE WRENCH.—A. W. KIRPER, 1909 N. Keystone Ave., Chicago, Ill. An object of the invention is to provide means for permitting a yielding movement of one of the jaws of the wrench relative to the other jaw to more positively grip a circular body, such as a pipe, between the jaws. A further object is to provide a device that can be instantly adjusted to work of varying sizes.

Machines and Mechanical Devices

WASHING MACHINE.—C. E. BEARDSLEY, 417 W. Allen St., Rice Lake, Wis. The invention relates to a washing machine in which the clothes will be rubbed upon and by surfaces corresponding to that of a washing board, and which will adapt itself within certain specified limits to any given mass of clothes, and produce a satisfactory cleansing action irrespective as to the small or large amount of clothes deposited for washing.

TURNOVER MACHINE.—L. GOLDSTEIN, 179 Hegel St., Brooklyn, N. Y. The object of the invention is to provide a turnover machine more especially designed for turning over tubular articles notably fur pieces such fur



A PLAN VIEW AND SIDE ELEVATION

paws and the like without danger of injuring the article during the turing operation and without requiring the use of a skilled operator. The machine is simple, durable and not liable to get out of order.

BOOK INDEXING MACHINE.—W. FARKAS and C. GREENSTEIN, 133 Lincoln St., Astoria, L. I., N. Y. Among the objects of the invention is to provide a book indexing machine arranged to permit of quickly and accurately cutting indexing notches into the leaves of a book. Another object is to enable the operator to cut the desired number of notches in a comparatively short time without undue physical exertion.

POWER TRANSMITTING MECHANISM.—W. E. ROSS, Box 268, Oil City, Pa. The invention has particular reference to an eccentric transmission device. An object is to provide an eccentric power transmission element in which the friction generated is reduced to a minimum. Another object is to produce an element which is compact and composed of a minimum number of parts. A further object is to provide an efficient lubricating means.

FLUID MEASURING MACHINE.—S. F. MIOTON, Medical Bldg., New Orleans, La. The invention has for its object to provide a measuring machine which will accurately measure fluids, the construction being such that when the machine has been once actuated the measuring process must be fully completed before the machine may be actuated a second time. Another object is to produce a machine with means by which different quantities may be measured.

LAWN MOWER.—H. L. RICHENDIFER, Box 83, Bladen, Neb. An object of the invention is to provide a lawn mower which will cut grass in awkward places not conveniently reached by the ordinary type of mower, and which will also cut weeds or other upstanding growth and not mash the same down as is the case with lawn mowers in ordinary use. This machine is strong, can be easily operated, assembled and taken apart for cleaning and repairing.

INDEPENDENT FEED RAIL DRILL.—W. F. MCCARTY, c/o Defiance Machine Works, Defiance, Ohio. The invention relates to metal working machines of the heavy service type, its object is to provide an independent rail drill more especially designed for use in locomotive and railway shops, gas engine and automobile factories, general machine shops and similar establishments, and arranged to permit of heavy gang drilling or heavy jig drilling. The machine is so compact that a single operator can keep a number of drill spindles, either single or in group, in operation.

MULTIPLE SPINDLE DRILLING MACHINE.—W. F. MCCARTY, c/o Defiance Machine Works, Defiance, Ohio. An object of the invention is to provide a multiple spindle drilling machine of inclosed unit construction and designed for simultaneously carrying on a number of drilling operations. Another object is to provide an automatic quick advance, slow work feed and a quick return of the drill spindles, thus insuring a high speed production without requiring attention on the part of the operator, except to place the work in position, start the machine, and remove the finished work.

MACHINE FOR MAKING MOLDS.—C. B. WORTH, 2448 W. Harrison St., Chicago, Ill. Among the objects of the invention is to provide a machine for making molds for castings having means for throwing mold forming material at high velocity directly into a flask. Another object is to provide a device that has means for varying the speed of operation of the sand throwing or projecting means, whereby the sand is packed with greater or less density as desired.

SHOVELING MACHINE.—S. J. KEILY, 2926 7th Ave., Miami, Arizona. This invention has for its object to provide mechanism for shoveling ore, dirt and the like, wherein a supporting platform is provided, having an inclined track on which the shovel runs, the car carrying a ram for loading the shovel, and power operated means for raising the shovel, the platform being mounted on a car and adjustable, with respect to the car.

LUMBER HANDLING MACHINE.—J. R. SEYMANSKE, 216 N. 10th St., Yakima, Wash. An object of the invention is to provide a machine adapted more particularly to handling railroad ties. A further object is to provide a mechanically operated device, the receiving end of which is positioned adjacent to a quantity of railroad ties while the other end is positioned at a place to which it is desired to transfer the ties, the ties being first manually placed on the receiving end from whence they are taken up without further attention by the operator.

REPRODUCER FOR TALKING MACHINES.—J. W. KAUFMANN, 1730 N. Monroe St., Baltimore, Md. This invention has for its object to provide a connection between the needle and the diaphragm controlling lever for transmitting in as perfect a manner as possible the movement of the needle, to provide for a softening of the tone and elimination of mechanical elements therefrom, as well as for increasing the volume of tone.

ROAD BUILDING MACHINE.—J. W. HALTSEL, Warren, Ohio. This invention has for its object to provide a machine especially adapted for tamping brick and newly laid concrete where a tamping member is provided of relatively large extent adapted to rest upon the surface of the pavement, and a ram contacting with such first named member to thoroughly tamp the brick or concrete, and cause the same to have a smooth surface.

PRESS BED MOVEMENT.—J. W. WEAVER, Box 371, Raleigh, N. C. The invention has reference to bed movement mechanism of one and two revolution cylinder printing presses, and other machinery requiring horizontal reverse action of uniform speed, precision and accuracy. An object is to provide stationary bearings of the driving pinion wheel with continuous mesh of said pinion wheel and gear teeth in a continuous alternating rack.

JACQUARD MECHANISM.—G. C. L. TISCH, 454 Spring St., Elizabeth, N. J. An object of the invention is to provide a drive adapted to be connected to any form of jacquard link wherein the power is transmitted through a form of mutilated worm which will act as driving means for links, also as means for rigidly holding the links in a certain position while the thread-carrying bars are being shifted. Another object is to provide a drive wherein the parts may be easily adjusted for receiving different sized driving members.

MECHANICALLY-OPERATED ADVERTISING DEVICE.—A. ASTON, 191 Broadway, New York, N. Y. The primary object of the invention is to provide means for demonstrating the action of what is known as a lever-type, self-filling fountain pen. The apparatus comprises a model of a pen or other article having a lever adapted to be given a swinging movement, means for raising and lowering the model, and for angularly displacing the lever.

PRINTING PRESS ATTACHMENT.—J. H. CUNNINGHAM, 584 Jackson St., San Francisco, Cal. An object of the invention is to provide means for quickly drying printed sheets as they are delivered from the press. A further object is to provide for introducing a current of heated air to the sheets to dry the ink, and to utilize the air pump which is ordinarily employed to operate the feeder for furnishing the current of air required.

PULSATOR FOR MILKING MACHINE.—A. D. ELLINGTON, Lock Box 481, Springfield, Ill. Among the objects of the invention is to provide a pulsator in which means is provided for alternately transmitting to teat cups or other parts of the machine pressure and vacuum impulses whereby squeezing and sucking actions are alternately produced. A further object is to provide a device in which

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Industrial Alcohol

(Continued from page 173)

Already the U S. Industrial Alcohol Company has erected a large plant for the specific purpose of making a motor fuel with an alcohol base on a large scale and it is operating on part capacity As soon as economic conditions permit the plant will be put in full operation. The first motor fuels of this type will have other ingredients to give the mixture the characteristic properties of gasoline But as gasoline is gradually replaced, it is reasonable to believe that better combinations will come into use and that the designers of internal combustion motors will alter their designs to get maximum economy from the fuel And this happy day for the motorist, there is every reason to believe, is not many years away

Cultivated Rubber

(Continued from page 166)

and in tapping the knife cut is made across these cells causing the latex, or milky white sap, to exude Lying just beneath the cortex is the cambium whose function it is to produce both latex cells and wood cells. Hence in tapping great care must be taken not to injure the cambium else the tree is seriously hurt.

When the tree is ready for tapping, the inspector passes it and guide lines are placed which are to be followed in the cutting Of the many methods of tapping the oldest is the V method, while the most popular method in recent years is known as the herring-bone method

In tapping, the incision is made entirely through the outer bark to the cortex and almost up to the cambium and a thin shaving removed

Immediately the tree starts to bleed—the latex, a thin milky fluid commences to trickle down the trunk of the tree. A glass or porcelain cup has been placed at the bottom to receive this After a few hours the flow gradually decreases and finally it coagulates and a clot is formed Then the tapper strips off the clot and makes a further incision.

Each tree will yield approximately three-fourths of an ordinary cupful of latex per day, and the tapping is done in the early morning in order to obviate the coagulating effect of the tropical sun

At five o'clock in the morning the tappers gather in front of the manager's house, roll is called, and the natives start on their rounds. Each coolie takes a basket, into which he puts the strippings of latex or clots of the previous day's cut. By nine o'clock he has completed his first round, also done the tapping He then starts his second round on which he collects the latex from the cups placed under the incisions.

The latex collected is taken to the factory and poured through a cloth strainer into a large "settling" tank, while the bark shavings are dumped into the "soaking" tank The fine particles of bark that may have fallen into the cups during the draining process are removed by means of a sieve—so too with any latex which may have formed into lumps. The strained fluid is allowed to settle, after which the top is skimmed, freeing the surface from any bubbles and small clots

And the coolies' work for that day has ended at noon

After the latex is strained and skimmed it is ready for the coagulating process. This is accomplished by the addition of acetic acid The fluid is then stirred with wooden paddles and allowed to stand over night. In the morning rubber is found floating on the top of the tank; it is a tough elastic mass of whitish color

This mass of rubber is cut into lumps weighing from ten to fifteen pounds, and these are run through washing machines and come out in long sheets which are placed over wooden bars to dry These sheets are known as crepe, and in the drying process the color is changed from white to a beautiful yellow. Some of these rubber sheets are smoked, changing the color to dark brown These crepe sheets are then packed ready for shipment, and start on their 10,000-mile journey to the manufacturer of tires—and one of the greatest achievements of mankind is completed—only to start another industrial romance

The Heavens in September, 1921

(Continued from page 168)

in the southeast. Aquarius and Capricornus have no bright stars but Grus, which barely rises above our horizon, is a conspicuous constellation for observers further south The eastern sky is a little better, with Taurus rising, Aries above, and the great square of Pegasus still higher

The Planets

Mercury is an evening star all through September He is hardly visible, however, until the latter part of the month, but at its end he sets at 7 30 P M and should be easy to see in the twilight Venus is still a morning star rising at 2 30 A. M at the beginning of the month, and at 3 20 at its close She is by far the brightest thing in the sky and cannot be mistaken Mars too is a morning star, rising at 3 40 A M in the middle of the month He is moving eastward in the sky, but not as fast as Venus, so that she gradually overtakes him and by the end of the month they are close together

Jupiter and Saturn are evening stars until the 21st and 22nd, when they come into conjunction with the sun within a day and a half of one another, Saturn being the first. On the morning of the 14th these two great planets are in conjunction and only a degree apart. A conjunction of these two planets is rather an unusual affair, occurring only at intervals of twenty years—Jupiter completing 1⅔ revolutions about the sun, and Saturn ⅔ of a revolution, in this interval This time, unfortunately, the two planets are only six degrees from the sun and there is no hope of seeing them, though they will be pretty close together when we lose sight of them early in the month

Uranus is well placed for observation being in 22h 38m 9s. R.A and 9° 29′ 37″ south declination on the 3rd, and in 22h 34 m 14s. R.A and 9° 52′ 38″ south on October 1st. This puts him from 2½ to 3½ degrees west, and a little less than two degrees south, of the fourth magnitude star Lambda Aquarii He is observable until long after midnight. Neptune is a morning star in Cancer and rises about 2 A. M, so that he can just conveniently be observed before dawn by anyone who has occasion

The moon is new at 11 P M on the 1st, in her first quarter at 10 P M on the 8th, full at 2 A M on the 17th, in her last quarter at 4 P M on the 24th, and new again at 7 A M on October 1st. She is nearest the earth on the 20th and farthest away on the 13th During the month she is in conjunction with Mercury on the 2nd, Jupiter and Saturn on the 3rd, Uranus on the 15th, Neptune on the 27th, Venus and Mars on the 29th, and Jupiter and Saturn again on the 30th

At the new moon which comes just as the month ends there occurs a total eclipse of the sun As in many other eclipses when the moon is some distance from its node, the shadow track lies entirely in the polar regions. Beginning in the south Pacific, it just misses Cape Horn, turns southward, and crosses the Antarctic continent to a point close to the south pole. It is doubtful whether the total phase will be seen by anyone except perhaps a few sailors, As a partial eclipse it will be visible throughout all South America below latitude 14° south.

Finally, it may be noted that at 9 20 A. M. on September 23rd, the sun crosses the celestial equator and enters the "sign" —though not the constellation—of Lyra. According to almanac reckoning, at this time autumn commences.

En route, C.P R R. west of Winnipeg,
August 19, 1921.

RECENTLY PATENTED INVENTIONS

(*Continued from page 174*)

means is provided for regulating independently of each other the pressure and vacuum impulses.

DISH WASHING MACHINE.—H. B. Oyer, 10 S Main St., Wellsville, N. Y. This invention has for its object to provide a machine of the character specified capable of attachment to an ordinary water faucet and having a circular brush adapted to be rotated by the flowing water and carrying a soap chamber which is rotated by the flowing water to deliver the detergent to the brush.

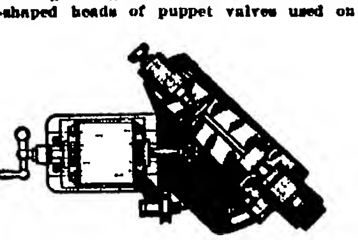
REPRODUCER FOR TALKING MACHINES —J W Kaufmann 1730 N Monroe St., Baltimore, Md The object of this invention is to provide a connection between the needle and the diaphragm controlling lever for improving the tone, making the reproduction more faithful and distinct and eliminating the disagreeable machine elements of the tone.

Musical Devices

VIOLIN —D H Neilly, 15 E Wash St Bradford Pa. It is the purpose of this invention to provide a violin so constructed as to produce sound vibrations in great volume and to secure a more perfect blending of sounds than is possible in violins as heretofore constructed. The body of the violin is formed of two separate and distinct sections arranged side by side and a string supporting bridge connecting the sections together.

Prime Movers and Their Accessories

GRINDING MACHINE —J O Rollins, Route 2, Box 681 San Gabriel Cal. This invention relates more particularly to a machine for grinding the beveled surface on the disk-shaped heads of puppet valves used on



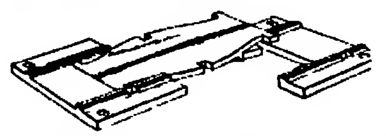
A PLAN VIEW OF THE MACHINE IN ACTION

internal combustion engines. The primary object is to provide a self-contained so to speak valve-grinding outfit which will enable any one regardless of their mechanical skill to effect a proper grinding or cleaning of valves or the like.

Railways and Their Accessories

LOCOMOTIVE DRIVER —J F McCarroll, Holden, La. This invention particularly relates to locomotive drivers of the gear type. The object is to provide a driver for any gear ratio, which is of such simple and compact construction that it resembles and partakes of all the advantages of the directly connected driver and which is possessed of a high degree of durability, is reliable in operation and easy and inexpensive to manufacture and apply.

RAIL CONNECTING AND SUPPORTING MEANS.—J H Jennings Georgetown Conn This invention contemplates an effective means of connecting and supporting the meeting ends of a pair of rails with - view to minimizing the jar incident to the passage of the wheels



A PERSPECTIVE VIEW SHOWING CHAIR MEMBERS AND BRIDGE PLATE REMOVED

over the rail ends. A further object is the provision of means for the meeting ends of the rails which prevents creeping with respect to the ties. The device may be readily applied and will eliminate the necessity of altering in any manner the construction of standard rails.

RAILWAY TIE AND RAIL FASTENER.—C E Estabrook, Springport, Ind A purpose of the invention is the provision of a tie or rail fastener so constructed as to be accommodated to different kinds of ballast, rails, rolling stock and climatic conditions the device is simple durable, efficient and capable of being adjusted to support the rails of tracks of different gages.

TRACK SUPPORTING AND FASTENING MEANS.—W O Batts, Wilmot, Kan The general object of the invention is to provide a permanent track bed as well as track fastening means, and means to buttress the track against spreading strains. More specifically the invention has for an object to construct a permanent bed of concrete doing away with wood cross ties. The construction is such that it will insure a properly drained road bed requiring little labor in its upkeep, and will produce an even strength over the entire road.

RAILWAY CROSSING.—R. E. Bowen, 1340 W 24th St, Los Angeles, Cal. This invention more particularly relates to a railway crossing in which provision is made for so forming the crossing tracks and wheel-flange grooves as to eliminate the bumping or pounding caused by the car wheels jumping across the grooves formed in the respective tracks.

SWITCH LOCK.—J M. Morrison, 76 Oak St, Plattsburg, N Y The object of the invention is to construct a lock which is incapable of being tampered with, and in which it will be impossible to effect a withdrawal of the key operating such lock until the switch has been completely thrown and locked in position A further object is to construct a device which should cause the actuation of a semaphore to indicate the condition of the switch should the same be other than completely thrown.

Pertaining to Recreation

GAME APPARATUS —R A G McCoy, 142 W 28th St, New York, N Y The invention relates to a game apparatus available for a large number of players, the apparatus involving an indicator and an annular series of designated areas relatively to which the indicator revolves so that the point of stoppage of said indicator determines the particular player to receive a count.

AMUSEMENT DEVICE — W C Hadley, 3 E. 43rd St, New York, N Y The object of the invention is to provide a device arranged to be supported upon the white keys of an automatic piano and having upon one of its surfaces the representation of a head of an animal or person from the upper jaw to the top, the upper jaw being located coincident with the lower marginal edge of the device and of a width corresponding to that of a white key so that when displaced on the white key the rise and fall will simulate the opening and closing of the mouth of the figure.

TOY CAR —A C Brown and S. P Smith, 25 Town St., Norwich Conn The invention relates to a toy car in which the car body is so mounted on supporting wheels as to not readily tip over when in use An object is to provide a toy car having a suspension for the body which will not interfere with the turning of the front wheels, and will allow either front wheel or rear wheel to be raised from the ground without upsetting the device.

PUZZLE —R. K Millard, 303 Halket St., Pittsburgh Pa. The general object of this invention is to provide a sectional puzzle made up of a definite number of sections of given shape whereby the given task of solving the puzzle may be varied within limits to add to the interest of the puzzle.

RACKET —G Aguttes, 57 Burns St., Forest Hills, L. I, N Y The invention has for its object to provide a tennis racket wherein means are presented which will materially strengthen the racket without adding weight thereto. Another object is to provide a racket having a metallic reinforcing lining for the wood head of the racket arranged in such a manner that the metallic reinforcement will overlap part of the head and will interlock with the handle.

AMUSEMENT DEVICE.—C F Gebert, 315 W 58th St New York, N Y An object of the invention is to provide a device in the nature of a wheel vehicle which is operated by means of a board fulcrumed between its ends and constituting in effect a seesaw adapted to receive riders at the respective ends and provide steering means under control of either or both of the operators so as to cause the device to perform amusing evolutions.

BASKET BALL GOAL INDICATOR.—R. Jackson, Jr., 329 Phelan Bldg, San Francisco, Cal. Among the objects of the invention is to provide mechanism in the form of an indicator for basket ball goals, which is adapted to indicate the fact that a ball has passed into or through the basket, by the sounding of a ball, which is struck by a lever as the ball passes into the goal.

Pertaining to Vehicles

TIRE CHAIN.—R. J Kleinbeck, Oxford Junction, Iowa. This invention has for its object to provide a chain comprising a plurality of sections which may be used either collectively or singly so that a single section may be utilized in case of emergency to release a car from a mud hole, where it would be impossible to apply the ordinary chains without the use of a jack.

OUTSIDE BRAKE.—C. Vancott, c/o Scientific Engraving Co., 406 W 31st St, New York, N Y More particularly the invention relates to an outside brake structure which can be applied to the brake drum of a well-known type of automobile which has heretofore been equipped with an inside brake structure to take the place of the inside brake structure, and by this change provide a brake which is readily accessible which is not liable to get out of repair but if it does can be easily attended to.

HEADLIGHT.—H. F Hammond, 116 Main St, South Shaftsbury, Vt. Among the objects of this invention is to provide in the ordinary headlights an arrangement of particles having dull surfaces which operate to prevent direct glare, but give full road illumination The dimming action is mainly applied to the rays which radiate in a straight line.

DIRIGIBLE HEADLIGHT.—W M, O. R. and N S. Lawrence, 2009 4th Ave., Birmingham Ala. The invention has for its object to provide headlights especially connected with the steering mechanism of an automobile to constrain the rays of light to turn with the vehicle, and to provide a supporting mechanism for the reflectors independent of the supporting mechanism for the lamps for permitting the reflectors to be turned without affecting the lamps. The attachment may be applied to cars of different sizes.

BABY CARRIAGE ATTACHMENT FOR MOTOR VEHICLES.—A R. Price, Oregon City Oregon Among the objects of the invention is to provide an attachment which may be connected with an automobile and which will provide an easy riding seat or couch for an infant so mounted that the shock and jar of travel will not be transmitted to the attachment, and wherein the attachment is detachable and collapsible.

AUTOMOBILE THEFT PREVENTING DEVICE —P Welliver, Hereford, Texas. The object is to provide a device of this character which will prevent the operation of an automobile by an unauthorized person The device works in combination with the engine of an automobile and may be easily operated by an authorized person acquainted with the combination.

TIRE VULCANIZING APPARATUS.—A L. Jacobson, 185 E. 93rd St., New York, N Y One of the objects of this invention is to provide an apparatus and a method of vulcanizing which will permit the tires to be properly treated without any portion of the mold or tire coming in direct contact with the moisture. A further object is to provide a device which will permit a number of tires to be simultaneously vulcanized.

RADATOR THERMOMETER.—G P Pitkin, Bergenfield, N J It is an object of the invention to provide a radiator thermometer construction for use in connection with automobiles and which can be read in the dark A further object is to provide a luminous thermometer which is supported in and forms a part of the cap or closure for the radiator.

STAKE —G B. Robertson, address Orville E. Cain, Cheshire House Block, Keene, N H The invention relates to stakes which serve to retain a load upon a vehicle. An object is to provide a stake which is adjustable within certain limits. A further object is to provide a stake which shall extend in such a manner as to firmly engage a load and prevent accidental displacement thereof from the body of the vehicle.

DEVICE FOR PROTECTING THE IGNITION SYSTEM OF AUTOMOBILES.—J H Bloodgood, 2006 Elmwood Ave., Tampa, Fla. It is a purpose of the invention to provide protection for the ignition system against the destructive action of the elements without modifying the construction of the hood and cowl by preventing water from contacting with the conducting wires and thus preserving their insulation and eliminating short circuiting.

VALVE.—G W Thompson, Cheboygan, Mich. The object of the invention is to provide a valve for interposition in the fuel line and in the oil supply line of a motor vehicle for controlling the flow of the fuel from a supply tank to the carburetor, by the pressure in the oil line, and so arranged that when the pressure is reduced below a predetermined point the supply of fuel to the carburetor will be cut off.

INLAID TREAD TIRE.—J. E. Dwork, 217 W. Kinney St., Newark, N. J. The foremost object of the invention is to provide in the casing the arrangement of which is such that the danger of puncture is fully guarded against, at the same time preserving the necessary flexibility of the casing. A further object is to provide a tire casing including means for preventing the displacement and lateral distortion of the tread.

BAND FOR FORD CARS.—J Milligan and C. E Little, Point Marion, Pa. This invention relates more particularly to clutch bands used in connection with automobiles for controlling the driving action or for checking the motion of the car, and to control the reverse and slow-speed drives and the brake, the construction is designed to facilitate the replacement of new linings, and to permit such operations to be carried out without disassembling the transmission assembly and casing or housing.

ELEVATING COAL TRUCK.—A. Kukielski, 19 Cook St., Jersey City, N J The general object of the invention is to provide a vehicle having a body adapted to be raised or lowered by parallel movement, and to provide an elevating body having an arrangement of discharge chutes adapted to discharge the coal either longitudinally of the vehicle or laterally together with means to control the flow of the coal.

SIGN —J P Fox, address Donohue & Gregley, 1st Natl. Bank Bldg, St. Cloud, Minn. This invention relates more particularly to a sign carrier especially adapted for use with automobiles or similar vehicles. An object is to provide a device which may be releasably mounted upon the extra wheel or tire generally carried so as to display advertising matter by means of suitable characters carried by the sign.

HUB LINER.—J W Wolfenden, 2323 Park Ave., Nashville, Tenn. An object of this invention is to provide a device which may be located around the drive shaft of a locomotive truck between the driving box and hub of the

A TRANSVERSE SECTION AND SIDE ELEVATION

drive wheel to take up lateral wear of the parts. A further object is to provide a two-part disk or ring constituting a hub liner which may be readily attached or detached to a shaft or journal without removing any of the other parts of the machine.

WINDOW CLEANER.—S. Yuasa, P O Box 48, Cupertino, Cal. The invention has reference more particularly to means for mechanically cleaning accumulations of snow, sleet, rain and the like from the surface of window shields or other windows so as to leave a clear vision through which the driver of the vehicle may clearly observe the road and traffic The device may be manipulated from the driver's seat.

Designs

DESIGN FOR A FURNITURE COVER.—Elsie M. Thompson, 56 W 47th St., New York, N Y

DESIGN FOR A PHONOGRAPH.—F Iucu-Lano, 323 E. 13th St., New York, N. Y

DESIGN FOR A TOY.—A. S. Buchman, 330 McDonough St., Decatur, Ga. The inventor has been granted patent on three designs representing a camel, an elephant and a goat.

DESIGN FOR A GOBLET OR SIMILAR ARTICLE.—S. Munich, 141 Roebling St., Brooklyn, N. Y.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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IN THIS ISSUE: THE ALL-AROUND VEGETABLE
RAPID TRANSIT ARITHMETIC

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

THE MAN-TESTING LABORATORY WHERE EXPENDED ENERGY IS MEASURED—[See page 187]

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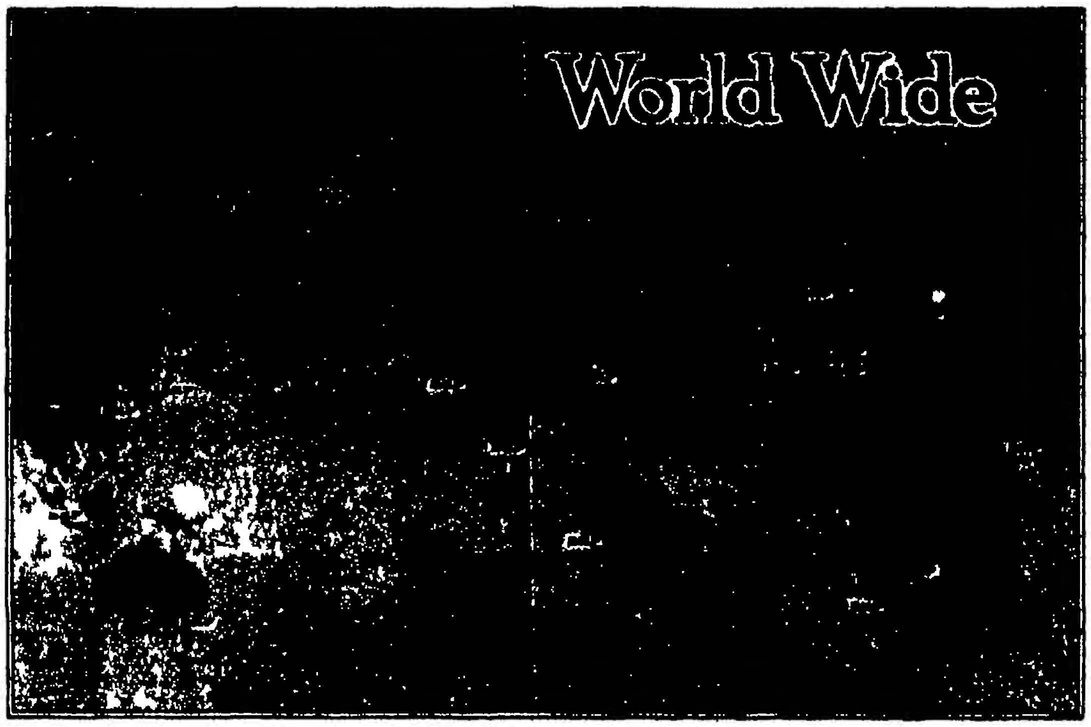

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SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXV NUMBER 11] NEW YORK, SEPTEMBER 10, 1921 [15 CENTS A COPY 20 CENTS IN CANADA

Announcement

The Scientific American publications are to be combined into a single monthly magazine. After seventy-six years of continuous publication the present Scientific American is to be enlarged both in physical size and editorial scope, and converted into a monthly, beginning with the issue dated November, which will be published October 20, 1921. Succeeding issues of the combined publications will be published on the 20th of each month This change has been determined upon for the following reasons·

In the month of January, 1920, the weekly Scientific American Supplement, after forty-four years of publication, made its appearance as a monthly. The advantages appeared to be so many, the drawbacks so few, that the change was made with full confidence that the Scientific American Monthly would meet with approval If letters of congratulation and increased circulation are the true test, the change has been an unqualified success.

For many months past the publishers have discussed the advisability of making a similar change in the parent publication, the Scientific American weekly Here also the practical advantages to be gained greatly outweighed the drawbacks. Reluctance to make the change was due perhaps more to sentimental than to practical considerations We are free to confess that after bringing out the Scientific American week by week for over three-quarters of a century, we feel a twinge of real regret in making this break in the long continuity It is done, however, for the very good reasons that, by combining the two present periodicals in a single monthly magazine, we can present the same material in a better balanced, and more complete and fully digested form, and at a far lower cost to the reader.

In the matter of contents and quality we can assure the reader of the present weekly and monthly that the new magazine, which will combine the two publications, will contain within its covers the best features and the distinguishing qualities of each, and will embrace all branches of Science, Research, Engineering and Industrial advance

An innovation, which we feel will be widely approved, will be that, as far as possible, each article will be completed on the page on which it appears, or on the pages immediately succeeding

Following the main body of the text, space will be devoted to various departments, and to a complete digest gathered from all of the technical journals, domestic and foreign, and covering the general scientific happenings of the month in a closely condensed and readable form

Among the longer articles will be found a selection of the best of the learned papers, read before technical societies, such as hitherto have appeared in the Scientific American Monthly, and it is needless to say that our present subscribers to the weekly Scientific American will find in the new journal all those characteristic features which have won for the parent paper such widespread approval.

The new Monthly will be greatly enlarged in number of pages, but will have the same sized page as the present Scientific American weekly.

In these days of heavy taxation and high cost of living, the question of price takes on special importance, and here it is that the change, combining the two periodicals into one magazine, affording opportunities of enormous economies in manufacturing, mailing, and in fact, in all the mechanical labor incident to production, enables us to make a very material reduction in the cost to our readers.

The subscription price will be $4 00 a year, and 35c a copy on the newsstands, as compared with $6 00 a year for the present Scientific American and $7 00 a year for the present Monthly In the new Monthly, however, we shall give in a single magazine costing $4 00, the technical literature which we formerly published in two separate periodicals

Subscriptions to either or both the Scientific American weekly and the Scientific American Monthly, which extend beyond October, 1921, will be adjusted and extended to equalize the difference in price.

The present weekly Scientific American and the present Scientific American Monthly are to be combined into a single monthly Scientific American. The first issue of the new combined monthly publication will bear the date of November, 1921, and will appear on October 20th next.

The new monthly Scientific American will retain the distinguishing characteristics of both of the present journals. It will have increased reading matter, more illustrations, and a broader range of subjects and interests.

The subscription price to the new monthly Scientific American will be $4.00 a year. The price per copy will be 35 cents.

The Scientific American, September 10, 1921 Volume 125, Number 11 Published weekly by Scientific American Publishing Company at 233 Broadway New York, N. Y Subscription price, $6.00 per year.
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Bending Strength of "ZR-2"

IF ZR 2 buckled while she was making a sharp turn at high speed - and more than one witness has testified that she did—she was the victim of a lack of girder strength which is inherent in all air ships of the rigid type By this we do not mean to say that all dirigibles are weak to the point of danger, but we do wish to emphasize the fact that the frame of a dirigible is so constructed that it cannot be considered as a trussed beam, and therefore its great diameter or depth cannot, as in the case of a bridge truss, be taken as a measure of its bending strength

This inherent weakness is due to the fact that the presence of the huge gas bags prevents the introduction of any longitudinal, diagonal ties across each section or panel To use those it would be necessary to provide gas-tight tubes passing diagonally through the gas bags—an obviously impossible construction An attempt is made to provide longitudinal strength by bracing and tying together the longitudinal girders and the exterior polygonal frames, so as to secure something of the stiffness of the shell of a tube, but the whole construction, to the eye of an engineer, looks extremely frail when it is applied as in this case, to a structure that is eighty five feet in diameter and some 700 feet in length

There is, of course, an interior truss running along the bottom of the framework—a triangular truss of great strength and stiffness—but it is shallow as compared with the vast skeleton frame along the bottom of which it lies When the heavy cross-bending strain, induced by setting the rudders hard over when the ship was running at high speed developed stresses of compression and tension were set up in the frame of the ship, which the relatively small triangular truss below could not do very much to relieve

In making the above suggestion we do not wish to throw any doubt upon the practicability of lighter-than air *navigation* Faults either *of* design material or handling existed in the ill fated 'ZR 2 , but this does not prove that dirigibles of the great size of this one cannot be built of sufficient strength to stand any of the reasonable mischances of the air Now that the wreck is being salvaged and the log of the Commander of the ship has been recovered we shall probably learn in due course just where the break occurred and why Every new art has its failures and alas, its disasters accompanied by large loss of life but the art goes forward We are among those who believe that the *day may come when gas bags can be eliminated and the* whole body of the ship sheathed with some light alloy so that it can serve as the container The all metal dirigible, for reasons of strength and safety, is as desirable as the all metal airplane

Marine Insurance as an Aid to American Shipping

EVERY possible legitimate assistance should be given to President Harding and the Chairman of the Shipping Board in the great task of salvage *of the Government fleet of merchantmen* which was built under exceptionally unfavorable conditions during the war Whatever legislation is enacted with this end in view, we should be careful while rendering every legitimate assistance to our merchant marine to avoid legislation which can be construed as actively hostile to the proper aspirations and efforts of other nations, and that would give them any just cause for resentment It is possible to avoid this antagonism and promote the interests of our merchant marine without stirring up bad feelings among the maritime nations which will be our active competitors, when the flow of traffic sets in again with full force

It is not yet fully understood how vitally important to the successful growth of our foreign commerce and shipping is a proper development of marine insurance in the United States. Both the United States Shipping Board and the House Committee on Marine Insurance state that marine insurance is used as a competitive weapon in international trade, and that it has indeed been so used by other countries in promoting certain leading lines of trade They state further that under existing conditions, marine insurance companies, because of marine insurance that is placed with them, acquire and utilize vital trade secrets which are *exceedingly useful to the nations these companies represent* Obviously, it is important that marine insurance should be taken out by American companies through American insurance firms.

Furthermore, companies dealing in marine insurance business in the United States are at a disadvantage in competing with foreign companies because of governmental (State) regulations and restrictions and excessive taxation All United States marine insurance companies in addition to heavy state taxes are subject to a further Federal tax of one per cent on their premium income, except *on exports*, and in addition to this, marine insurance companies are subject to the same taxes as other corporations in the way of income and excess profit taxes and capital stock taxes.

As compared with this heavy handicap, marine insurance on American property placed with companies outside the United States is subject to a stamp tax of 3 per cent on a gross premium, except on exports Outside of this 3 per cent, marine insurance companies in England and other foreign countries are not required to pay a tax on premiums but are subject to such taxation *as is* imposed on ordinary business. The Insurance Committee of the Merchants' Association in this city favor the following changes in the insurance laws of the State as recommended by the House Committee on Merchant Marine and Fisheries That taxation of premiums be abolished and a tax on net profits substituted, that permission shall be granted to marine insurance companies to engage in all classes of insurance excepting Life and Surety, that unnecessary restrictions upon re-insurance with companies of other states be removed, that marine insurance companies be allowed to take credit in their financial statements for foreign deposits and premiums, and lastly, that there should be a recognition of the necessities of marine insurance by special legislation

A bill intended as *a* model for use in the various states has been introduced in Congress. It incorporates the features we mention above, with the added proviso *of a tax of* 2½ per cent on the *gross* premiums of any marine insurance placed on American-owned property outside the United States through a marine insurance broker This tax would be additional to the 3 per cent stamp tax which we have mentioned above

A Detail of Patent Office Examination

PERIODICALLY we read of the over-worked examiners in our Patent Office Periodically we are informed that this is the reason for the un*fortunate delay in the issue of letters* patent *for* inventions. This unsatisfactory condition, however, is not peculiar to Washington, in the patent offices of most foreign countries applications lie dormant for considerable periods owing to the inability of the examining staff to cope with the demands upon its time

Holland, one of the most recent countries to enact patent laws, and therefore unhampered by the traditions which necessarily cluster about a business that has been going on without material change for a century or more, has recently amended her patent laws in a way that enables the Dutch examiners to avoid a great deal of duplication of work that has been already done elsewhere. It is provided that, where application for a Dutch patent follows or is coincident with the prosecution of applications in countries foreign to Holland, the Dutch examiner may review the art cited by the Patent Offices of other countries. With the authorization of the applicant, the Dutch Patent Office will obtain from its contemporaries abroad such information from the file wrappers relating to the same invention as may be useful in providing the groundwork on which the Dutch examiners may continue their searches. This will make unnecessary many duplicate searches, and will relieve the Dutch examiners of a great volume of work.

With the work of our own Patent Office so hopelessly in arrears, it might be well to consider a similar change of procedure here. Where the applicant for a patent has filed applications in other countries, if our Patent Office were authorized by him to obtain information concerning all the references which were cited by the foreign Patent Offices during the course of the examination of applications on the same invention, our examiners would have before them a fairly complete history of the art, which could then be augmented to any *extent necessary by further and independent search*

The American examiners of course would have to be free, both legally and in their own minds, to draw their own conclusions as to the patentability of the subject matter of an application that had been treated in this way But we hope that the caliber of our patent examiners is sufficiently high to enable us to trust them in the presence of another man's work, without the fear that they will permit that work to influence them unduly It seems absurd for each Patent Office to go on making its searches indepen*dently, duplicating a great amount of exhaustive work* that has been done elsewhere · just as absurd as though we were to sit down with the intent of writing a history of Rome to rival Gibbon's monumental work, and were to refuse to avail ourselves of the list of sources which Gibbon gives us, preferring to tour the museums and libraries of Europe and examine all the ancient documents there to be found, in search of our own sources. It is not a question of allowing Gibbon's treatment of his sources to influence us, the exact parallel is as we have put it—refusing to use his sources until we have discovered them *independently* Anyone will agree that this would be irrational, it is in no degree more so than the Patent Office procedure of today, which refuses to recognize the existence of digests of the art not made on the premises.

Technical English

EVERY now and again we find, in our technical and scientific journals a plea for greater attention to correct diction We are not over optimistic as to the result Perhaps more can be accomplished by pointing out two or three of the most common errors. The use of "data" as a singular noun has become too common. Is it really necessary to remind technical writers that *data* is the plural of *datum?* It is true that the English language permits the occasional use of a singular verb when the subject is a plural noun denoting a collection of things. But this construction is exceptional. Who would think of saying "In view of *this facta?*" Yet there is no more warrant for saying "In view of *this data.*" No, we strongly suspect that those who adopt the faulty construction are blindly and uncritically following a lead that has become all too general Let us make an effort to break this lead A good beginning would be made if Government publications would set the example Our various departments at Washington would seriously resent any charge that they were spreading scientifically unsound information. Why should they not be equally jealous of the correctness of the English diction to which they lend their endorsement?

Another extremely common phrase, which is, to say the least, inelegant, is the use of the word "due" as a conjunction We quote from a standard work "By 1809, *due* to the fact that the turnpike system had been extended, there were over one thousand turnpike trusts to keep the roads in repair" The word "due" is etymologically a participle of adjectival function; the correct conjunction to use in such cases is "owing to."

As for the confusion of the verbs "shall" and "will" this, in common business correspondence, has become so prevalent that it seems rather hopeless to attempt to restore order And yet the rule is so simple · In the first person use "shall," thus "I shall, we shall"; in all other cases use will. You will then be expressing merely futurity of the event. The word "shall" used with the second or third person expresses not mere futurity but some form of constraint, compulsion, or obligation Similarly the word "will" used otherwise than as indicated above, expresses not mere futurity but an act of the will.

Let us, in print at least, put on our best literary garments.

Electricity

Pliers with Renewal Jaws.—The cutting jaws of the electrician's pliers are nicked and dulled long before the rest of the tool is rendered useless, hence there has always been a demand for some form of renewable jaws. This is realized in a recent tool introduced on the market. The new tool is a plier made in two parts, so that when the jaw is broken or worn out it can be removed and a new one inserted. The manufacturer states that the jaws of the new pliers are made of crucible steel and the handle or body is made of forged steel.

Italian Railway Electrification.—Work on the general electrification of Italian railways is proceeding actively. At the end of August of last year, ten roads, comprising a total of 797 kilometers, had been electrified. From September 1, 1920, to June 30, 1921, five additional roads, comprising 234 kilometers of road, were electrified During the current year 484 kilometers of road will be electrified The saving in coal resulting from these electrifications amounted at the end of June to 160,000 tons. By July 1, 1922, it is calculated, the saving in coal will reach 1000 tons a day, causing a daily saving of 200,000 lire, or 70,000,000 lire annually

Safe Industrial Lighting.—In general, according to the *Transactions* of the Illuminating Engineering Society, bad lighting is caused by one or both of two outstanding factors—(1) bare incandescent lamps, or unshielded glaring illuminants that not only do not illuminate but cause a contraction of the pupillary opening of the eye and resultant decrease in seeing ability, (2) insufficient light, which is largely due to improper lamp renewals, wrong methods of reflector and lamp cleaning, color of surroundings, or lack of efficiency in maintaining the original installation up to its initial standard The latter factor particularly is discussed in this article

How a Speaker Could Address Our Entire Population.—A record in projecting speech has been established by the American Telephone & Telegraph Company at an experimental station in the Catskill Mountains, according to *Electrical World*, where a speaker's voice was made intelligible 3 8 miles away through the medium of a loud speaking telephone The equipment is similar in some respects to that used at recent out door addresses to large audiences but has considerably greater amplifying power It consists chiefly of electrostatic transmitters setting on the pedestal on the speaker's platform, vacuum tube amplifiers in cascade, and the loud-speaking projectors mounted over the speaker's stand A single projector established the record, the energy amplification being 10^{12}

Peter Cooper Hewitt.—It is with deep regret that we must note the passing away of Peter Cooper Hewitt, the American inventor who contributed so generously to electrical progress. Mr Hewitt underwent an operation recently for abdominal trouble, and death resulted from an attack of pneumonia Peter Cooper Hewitt was born in New York on March 5, 1861 He was the son of Abram S Hewitt, one time Representative in Congress and Mayor of New York, and grandson of Peter Cooper, the philanthropist. He was educated at Stevens Institute of Technology, Hoboken, and at Columbia University, graduating as mechanical and electrical engineer Mr Hewitt is best known for his mercury vapor lamp, which is widely used for many purposes, notably photographic illumination, his mercury vapor rectifier for converting alternating current into direct, and certain improvements in telephony and radio communication Of late years he was engaged in developing a helicopter

Wireless Control of Locomotives.—According to the *Revue Generale des Chemin de Fer*, a series of tests on electrical intercommunication between two electric locomotives driving the same train is now in progress between Paris and Juvisy The system, which was patented in 1917 by the Orleans Railway Company, consists of an arrangement whereby the locomotive at the head of the train produces a periodical secondary current of low voltage and relatively high frequency This current is superimposed on the power current and is transmitted by the ordinary circuits which supply the two locomotives. In the locomotive at the end of the train selective receivers are installed which allow different effects to be obtained according to the form of the current transmitted These secondary currents are used principally for operating the contactor and braking equipment and, of course, avoid the use of a driver at the tail of the train The arrangement is, obviously more useful on mountain sections where locomotives are used at both ends of the train than for motor trains operated by an ordinary multiple-control system.

Astronomy

The Pons-Winnecke Radiant it appears will supply the earth with no further meteors in addition to those of June, 1916. Professor Barnard and other observers watched all night on June 24th, 25th, 26th and 27th, without results. This makes it appear that the denser part of the meteor swarm did not intersect the orbit of the earth at all

Proper Motion Statistics.—Kapteyn and Van Rhijn, in the latest of the Groningen publications, No 30 discuss among other things the total number of stars known with proper motion in excess of two tenths second of arc and of magnitudes between 6 and 14 It appears that there are 10,198 such stars known of which 100 are of the brightest magnitude considered—the sixth—while 76 have motion of two seconds or more The table given shows a complete classification of these stars by magnitudes and by amount of motion, the latter being divided on each tenth-second from 0 2 to 1 0, and then at 1.5 and 2.0 seconds.

Thickness of Saturn's Rings.—In connection with the passage of the earth through the plane of Saturn s rings last November, Prof. W H Pickering s observations in Jamaica led him to conclude that while the thickness of the outer edge of the outer ring *A* can be only a few miles, that of the inner edge of the inner ring *B* is some 40 miles greater, while the thickness of the crape ring is about 1000 miles. The latter he believes to consist either of innumerable small distinct clouds of ice crystals, like our cirrus, or possibly of a uniform cloudy structure of extreme rarity, the temperature of the minute drops of water being maintained by their proximity to the hot planet

Interference Methods in Astronomy.—In *Nature* for July 28th appears a comprehensive article by H Spencer Jones, Chief Assistant at the Greenwich Observatory, upon this subject. While hardly more complete from a popular viewpoint than Dr Russell s articles in our own columns, it gives considerably more material of exclusive interest to the astronomer The layman s chief reaction to this article will be amazement at the assurance with which such magnitudes as 0 0458 and 0 0451 *second of arc* are discriminated Modern precision measurements are decidedly more startling when applied to the minute evaluation of angles than to ordinary linear dimensions

A Double Service of Astronomical Telegrams.—The action of the Interallied International Astronomical Union in establishing a new bureau for the exchange of astronomical telegrams at Uccle, Belgium, intended to supplant the long-established institution at Kiel, has had the result that might have been expected In the early days of the war the work of the Kiel bureau was, very properly, transferred to a neutral establishment, viz., the Observatory of Copenhagen The Allied countries, however, established a provisional bureau at the Observatory of Paris, which transferred the work to Uccle in 1919 Meanwhile the Observatory of Copenhagen, under Professor Strömgren, continues to act as the distributing point for astronomical telegrams from the Central Powers and certain observatories in other countries. Fortunately an agreement has now been reached between the bureaus at Uccle and Copenhagen so that each receives and distributes to its subscribers the telegrams received from the other

Observing Sunspots Without a Telescope.—Every astronomer is familiar with the controversies that have arisen concerning the true character of minute planetary markings, especially those observed on Mars. In order to determine how much dependence should be placed upon the human eye in this connection, Mr E Walter Maunder, in England, organized about two years ago a corps of volunteer observers who undertook to make a systematic daily examination of the sun for the detection of sunspots without telescopic power (*i e*, using only a dark glass) His idea was that a comparison of these observations with simultaneous telescopic observations and photographs would serve to throw light upon the limits of naked-eye vision A preliminary report on this undertaking states that of 259 days of observation 96 showed spots visible to all who were observing on those days On 23 days discordances were noted between observers. A sunspot with area less than 700 millionths of the sun's disk at mean distance appears to be too small to be detected by average good sight. On the other hand, the observers seldom failed to secure a definite observation of any spot that covered 900 millionths or more To express the same thing in another way, a well-defined circular dark spot on a bright background should have a diameter of 31 seconds of arc to be visible to the naked eye, while one having a diameter of 36 seconds ought not to escape a careful search made under good conditions.

Industrial Efficiency

Osmiridium Deposits.—Recent exploration and development have revealed enormous deposits of osmiridium and gold-bearing gravels in the valleys of the large rivers of the western division of Tasmania, which is the sole producer on a large scale of point metal osmiridium Tasmania Russia, Colombia and Papua are the four principal osmiridium producing countries of the world, and Tasmania is by far the most important of these.

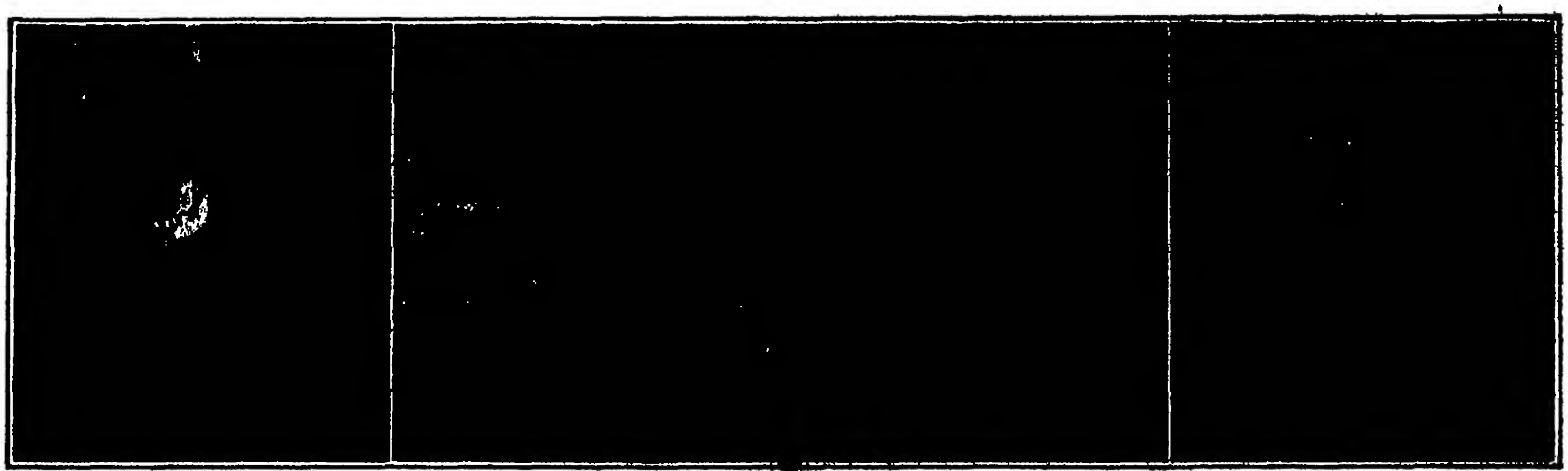
The Total Value of Our Foreign Trade in merchandise dropped from \$13,347,000,000 in the fiscal year 1920 to \$10 171 000,000 in 1921, a decrease of \$3,176,000,000, or at the rate of 23 8 per cent This loss was nearly equally divided between imports and exports. Imports dropped from \$5,238 000 000 in 1920 to \$3,654,000,000 in 1921, a loss of 30 2 per cent while exports, amounting to \$8,109,000 000 in 1920 against \$6 516,000,000 in 1921, decreased \$1,593,000 000 in value, but only at the rate of 19 6 per cent.

The Handbook of Northern Wood Industry, or to give it the original title, *Handbook för Nordisk Träindustri* which is well known in all circles connected with the wood industry and covers all information in regard to timber, wood pulp and paper industries in Sweden Finland and Norway, has just appeared in a new 1921 edition The preceding edition was published in 1918 and changes and extensions in the Northern timber industries have taken place especially during the war so that it became necessary to publish a revised edition The handbook contains detailed information concerning industrial combinations and export organizations in the different countries in the sphere of the wood, wood pulp, and paper industries, with complete lists of the members of the boards and associations

Again the Question of Packing.—Many wood packing cases arrive at their destination broken, with the contents damaged because the man who nailed the box or crate together failed to put in the right number of nails A good rule is to space the nails not more than two inches apart, states an authority writing in *The Times Trade Supplement* except when nailing up crates or boxes whose sides and so on consist of more than one piece In such cases the narrow pieces must never have less than two nails in each nailing end and if more than 2 inches wide the number of nails must be proportionately increased Bales should not be bound with rope American firms have lost many good orders through 'tying their parcels with a bit of old string" The best ties are painted iron or steel strips about 1¼ inches wide at least and 7 to 8 inches apart

The Division of Commercial Laws, a newly created division of the Bureau of Foreign and Domestic Commerce is prepared to receive inquiries from American business men and lawyers relating to commercial laws of foreign countries, the taxation of American firms doing business abroad, formalities in connection with bankruptcy proceedings in foreign countries powers of attorney, etc The Division will eventually have a complete library of civil and commercial codes of foreign countries as well as of representative foreign law publications In cooperation with the consular officers, commercial attachés and trade commissioners a file of reputable law practitioners in the important commercial centers will be prepared for the convenience of American business men and their council, but without any obligation or responsibility being assumed by the Division in this connection The scope of the operations of the new Division is rather large and it has been designed to meet the long felt need for an information center on foreign commercial laws

The Unemployment Situation varies from one country to the next Thus in the United States the unemployment situation appears to be getting worse rather than better while in France it is getting decidedly better Our own country is faced with the none too pleasant thought of having perhaps as many as five million unemployed—New York City alone expects half a million unemployed during the winter, although a goodly proportion of this number is the influx from other parts of the country In France, on the other hand, the unemployed totaled in the neighborhood of 100 000 up till a short while ago, and at this writing the number has receded to about 70,000 There are no definite statistics on this subject, but the French Government reports that the number of unemployed assisted by the Government reached 47,124 in January, 1921, and increased to 84 810 on April 30th, but on June 24th it had receded to 54,002 The German unemployment situation is reported to be improving rapidly The British situation is still dark and uncertain



Left: The geologist has located a readily accessible bed of gravel, of fine wearing surface. *Center:* Deciding on the most favorable location for a road foundation. *Right:* Consideration of the road-building materials near the site has as much to do with placing a road as has the character of the actual roadsite

Where the geologist lends his aid to the difficult task of locating the road

The Geologist's Part in Road Building

How Wisconsin's Highways Are Located with Expert Scientific Advice

By George H. Dacy

PROFITING by the mistakes of other states that have markedly increased road building expenses by not efficiently surveying the sections which the roads penetrated previous to construction in order to locate all available material, the Wisconsin State Highway Commission is making unique utilization of the trained geological experts on the Badger payrolls. These geological experts make complete surveys of the road building material resources of the belt through which each new road—be it gravel, macadam or concrete—passes before the initial road improvement activities are started in order to appraise accurately the debits and credits in rock and gravel materials available locally In each instance, this survey is extended back ward from either side of the road a distance equal to the wagon haul from the nearest railroad town

One of the most critical expenses in building improved highways under existent conditions is the cost of transporting road metal from distant supply points and, subsequently, of freighting it by wagon or motor truck to the rural construction location By her efficient use of scientific and geological skill, Wisconsin is eliminating this avoidable expense—in many instances—from her highway construction bills, while in other cases, she is reducing it to a minimum by the economical, supplementary use of imported materials as reenforcements for her local resources In dollars and cents, this saving foots up to big amounts as is illustrated by the fact that last year according to the advance geological survey practiced in Badgerdom, adequate amounts of local sand and gravel were secured at an average cost of \$1 40 a cubic yard whereas the same materials from commercial pits would have cost an average of \$2.85 a cubic yard

Assuming the average railroad haul at 5 5 miles, the use of local material of this description results in an additional saving of \$1 11 a cubic yard for transportation costs. This figures up to a gross saving of over \$3000 a mile of concrete road Furthermore an economy in truck and wagon haul aggregating from \$1650 to \$3900 a mile often obtains per mile of highway constructed As a rule the customary hauling charge is 50 cents a ton for the first mile of wagon or truck haul and 25 cents a ton for each additional mile Improved highways usually are built out from central railroad towns to which the materials are shipped by rail and then hauled over the road When the construction work reaches a point 8 to 10 miles from the railroad, the freighting charges attain exorbitant dimensions

It is worthy of mention that Wisconsin's state highways which now cover 7500 miles and are maintained in excellent condition by 911 patrolmen who individually maintain stretches of roadway averaging over 8 miles a man constitute one of the best chains of improved pathways east of the Rocky Mountains. The geological surveys in addition to being fruitful for the original location of local material for constructing the roads are also of inestimable importance in providing material for the repair and proper maintenance of the highways. The all round efficiency of a roadway is measured in terms of its maintenance Wisconsin roads are among the best because proper surveys have been instituted to render available main tenance material for present and potential needs Last year Wisconsin expended \$2,125,000 in maintaining 7500 miles of highway It cost \$1 87 a mile to keep the earth roads of the state in repair; \$1 84 a mile for the gravel roads, \$540 a mile for macadam and \$220 a mile for concrete roads Just compare these expenses with those of any other state which does not follow the geological survey system and you will immediately appreciate how important is this reconnaissance work as measured in annual upkeep costs

During the current motoring season Wisconsin is featuring another innovation in the way of special road condition, report service It takes the form of a blue print map of the state appropriately showing all the trunklines and important highways and their condition This map is issued Wednesday of each week and is distributed to nine branch stations of the State Highway Department in leading cities as well as among the most important hotels. The map is 54 by 00 inches in size and must be displayed on a special bulletin board placed in a conspicuous position in the lobby so that the general public may avail themselves of the information it supplies. The map is issued the middle of the week so that all tourists and motorists planning week-end trips may have most recent road information at their service The map describes the kind—earth, gravel macadam or concrete—of road and its condition whether it is under repair, the condition and character of the detours and other facts of interest to automobilists Supplementary weather report service is furnished by the U S Weather Bureau from Madison, Wisconsin, daily to all the parties that receive the maps so that the motorist may also benefit by these reports about the potential antics of old Sol and Jupiter Pluvius

The geological surveys in many cases have resulted in a complete change in the type of proposed road construction followed For example, in one neighborhood the intention was to build a temporary gravel road The survey showed that the supplies of local gravel were very limited and that a concrete road would be the most efficient and satisfactory highway to build in that section In some of the sandy sections of the state, clay proves to be the best material to use for surfacing above the sand Search is ordinarily made for shale in the sandy sections as this material is ideally adapted for highway use In some of the counties where granite prevails in large quantities the purpose of the survey is to locate accumulations of disintegrated granite as this material makes a very satisfactory and durable road. The granite wears well and sheds water admirably Briefly, the intensive studies and observations of the Wisconsin geologists is resulting in the standardization of the highways in accordance with the character and type of the local road material supplies. Wisconsin has realized such success as a consequence of using her state geologists as prize aids in her road building campaign that recently Pennsylvania Maryland Illinois, Missouri, Minnesota and Iowa have copied her methods and now are decreasing their highway construction expenses in a similar manner

Dicyanin

SOME years ago, Dr Kilner, late electrician at St. Thomas' Hospital, London, whose book on the human aura is well known, said that the discovery of a screen to make the aura visible was not accidental He had been reading about the action of the N-rays upon phosphorescent sulfide of calcium and had experimented upon mechanical forces of certain bodily emanations.

Early in 1908 he thought certain dyes might help him, and fixed on the coal tar dye dicyanin

When the dye was obtained glass screens were made, the only satisfactory ones being glass cells filled with an alcoholic solution of dicyanin.

It was recognized very early that constantly looking through the dicyanin screens had an influence on the eyesight, an influence which is not altogether understood today Everyone who uses the screens finds the eyesight markedly improved. Most were slightly presbyopic.

Modern commercial photographic plates were found comparatively insensitive beyond λ50, but experiments at the Bureau of Standards, Washington, D C., convinced the experimenters that with dicyanin it would be possible to get the specter of bright stars as far as λ80.

But the dye deteriorated quickly and there was ignorance of the spectral region in which dicyanin was most valuable Dicyanin could not be depended on to preserve its useful properties indefinitely under ordinary conditions. Some change took place which destroyed its sensitizing value

The fact that dicyanin does not sensitize the plates to green and yellow is apparent from the photographed spectra The blue and red portions of the spectra are usually separated by a gap representing the insensitive organ The addition of pinaverdol to the staining bath is an improvement.

Staining Solution	cc.
Distil water	140
Ethyl alcohol	120
Dicyanin A (1 2000)	18
or Dicyanin 1 1000	7
Ammonia, 26 degrees	9

The human aura consists of a number of layer or strata one beyond the other extending out into space. There is the "etheric double," which entirely surrounds the body, conforming to its shape. Beyond this is the inner aura, 2 or 3 inches broad, and, beyond this again, the outer aura extending 5 or 6 inches, the outer part of which is termed the ultra-outer double.

Dr Kilmer thinks the force from which the aura arises is generated within the body itself He tells of details concerning the effect of electricity and chemicals on the inner aura, and the changes in shape and size of the aura generally as the result of nervous disease.

Developing Motion Picture Film with Automatic Machinery

By Harry A. Mount

IT will be a surprise to many persons to learn that in this day of labor-saving machinery most of the millions of feet of motion picture film in use is developed by hand. This is because the machines hitherto devised for the purpose of developing film have been cumbersome and expensive and not fast enough to make their installation profitable except in one or two of the largest film laboratories.

A new film developing machine recently placed on the market apparently overcomes these difficulties. Although it occupies a floor space only eight feet long by two and a half feet wide, and is four feet eight inches high, it develops a thousand feet of film an hour, delivering the film dried, ready for the projector. Another model, double this length but with other dimensions the same, will have a capacity of four thousand feet an hour.

The machine is almost entirely automatic in its action, requiring the services of only one operator who has simply to watch for over- or under-exposed film and to slow down or speed up the passage of the film through the developing tank accordingly.

The tank is constructed of boiler iron heavily nickeled inside and out. It is divided into six compartments, one each for developer, wash, fixing bath, wash, final wash, and drying. The first four of these are arranged on one side of the machine and the other two are placed on the opposite side with a water jacketed partition between. The heat of the water in this jacket controls the temperature of the developing and fixing baths. The film passes with a helical motion up and down through the solution and finally into the next compartment. Offsets in the partitions allow this passage from one compartment to the next without a twist in the film. The air for the drying compartment is forced in at the bottom by a blower, passing over electric heater coils which slightly warm it. The film is uniformly dried, regardless of weather conditions. There is an air brush attachment for tinting the film during the development process.

The whole mechanism can be lifted clear of the tank by a compressed air cylinder, so that breaks can be mended and adjustments made quickly. While in this position the action of the developer is delayed by a water spray which plays on a portion of the film. An automatic device stops the machine if a break occurs, but this is a rare occurrence. In fact, over fifteen thousand feet have been developed on the machine pictured without a break in the film or any other trouble.

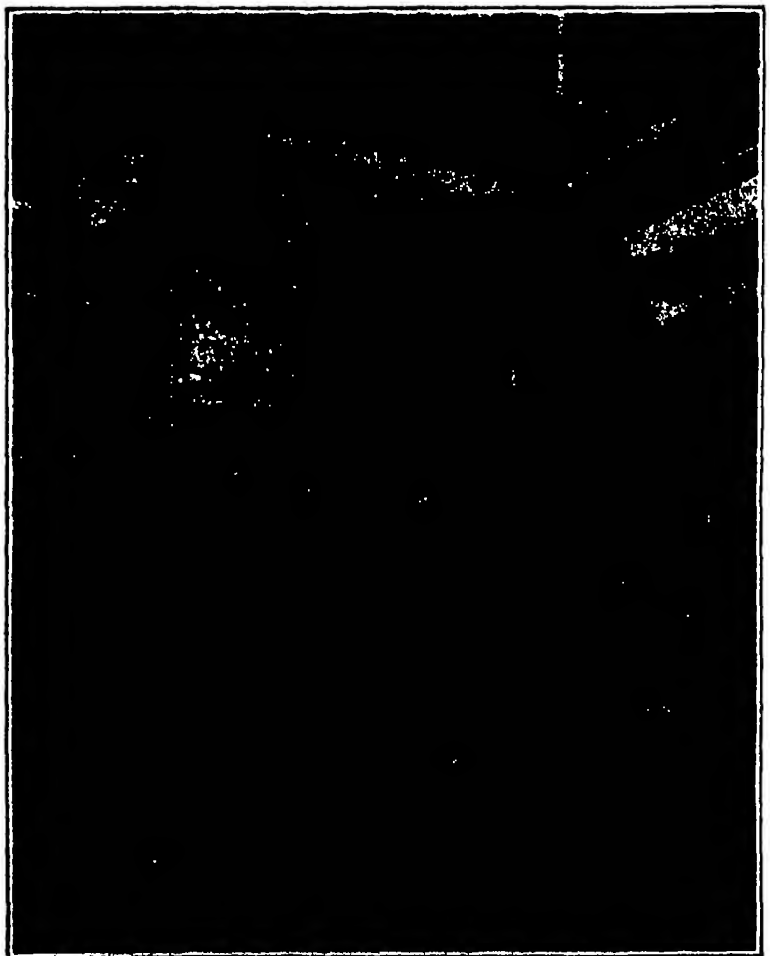
A combined flushing and siphon system makes it easy to clean the machine, only fifteen minutes a day being required. The machine is operated under a ruby light, and five small lights behind the film allow the operator to examine it during development.

The usefulness of such a machine to large motion picture concerns may be judged from the fact that the small machine pictured below takes the place of a whole film developing laboratory occupying 1500 square feet or more of floor space and employing a number of men.

Another film developing machine, which, in its general principles, resembles the machine already described has recently made its appearance. It is said to eliminate all the undesirable, expensive, wasteful and inadequate laboratory methods, much cutting and splicing, reducing splices in each one thousand feet from forty or more to not more than two splices in each one thousand-foot reel, excessive use of expensive and rare chemicals; seventy per cent of the laboratory help; all loss from careless or inferior development, all loss from accident to film; all loss from dirt, dust or marks on the film; all loss from scenes or parts mislaid or lost, all loss from over printing of sectional parts.

This machine, which is shown in the upper illustration, is intended for positive film, which has a slower emulsion than the negative stock and can be developed in much brighter light. Furthermore, the positive stock has a greater latitude of development, which allows for the handling of many different scenes, with different exposure values, in one strip. It is a question whether the usual run of negative, with over-exposed and under-exposed sections, could be so handled.

An automatic motion-picture film development machine. The film contained in the magazines is passed to the rollers and tanks at the left



Another type of automatic motion-picture development machine, with the film-handling mechanism raised to remove the film from the tanks

Water Level and Weather Observation Station at the Salton Sea

By John Edwin Hogg

IN all the years that the Salton Sea has been the object of human interest because of its constantly varying water levels, temperatures, and degrees of salinity, no accurate scientific data concerning it exists. Similarly there is no accurate data concerning the weather conditions existing about this great inland sea which is the only body of water in the western hemisphere with its surface below ocean level and the lowest body of water on earth with the exception of the Dead Sea of Palestine.

In 1904 it is known that the Salton Sea was 266 feet below sea level, and in 1905 its surface level changed to 246 feet below sea level when the Colorado River overflowed and flooded its great below sea level basin. Since the flood of 1905 the surface of the Salton Sea has constantly raised and lowered, depending upon the rapidity of evaporation, which is the only means by which the sea's level is lowered and the amount of water flowing into it from surplus irrigation water from the Imperial and Coachella Valleys and the several fresh water streams flowing into it.

Since a valuable fishing industry has come into existence on the Salton Sea, and billions of dollars worth of irrigated lands are dependent upon the conditions existing there the Government has realized that accurate water level, water analysis, and weather data, are of great importance, and an observation station was recently (May, 1921) established on Mullet Island, a small volcanic plug that protrudes above the surface near the Imperial County (California) shore. The observation station has been placed by the United States Weather Bureau at Washington, in charge of Captain Charles E. Davis, the originator of the fishing industry, who lives on Mullet Island. Henceforth daily reports are to be kept, and placed on file at Washington concerning the Salton Sea.

The Salton Sea observation station is located at a lower negative elevation than any other institution heretofore established. The observation station at Furnace Creek on the floor of Death Valley formerly held that distinction, it being 187 feet below sea level. The Furnace Creek station, however, is eclipsed by the Salton Sea station with its elevation of 257 feet. It may be said that the Furnace Creek station is not located at the lowest point in Death Valley. The greatest depression in Death Valley is the Frying Pan Salt Marsh, which is 280 feet below sea level. The Salton Sea is 68 feet deep at the deepest point yet sounded so that if it ever dries up completely as has often been predicted, a depression 325 feet below sea level would be left. This would create a depression 45 feet lower than the lowest point in Death Valley which is now the lowest point of dry land on the western hemisphere and the lowest on earth with the exception of the valley of the Dead Sea which is 1300 feet below sea level. Thus should the Salton Sea evaporate it would supplant Death Valley as the second deepest depression on the surface of our planet.

Should the Salton Sea ever raise its surface to ocean level as it threatened to do when the Colorado River overflowed into it in 1905, portions of three enormous California counties which are all below sea level would be inundated. This below sea level area embraces the entire Imperial and Coachella Valleys, whose irrigated farms are among the most productive on earth, valued at billions of dollars, dotted with numerous prosperous cities, and producing millions of dollars annually in the value of crops alone. On the other hand, should the Salton Sea ever recede to the point of increasing its salinity beyond the endurance of fish life, the valuable fishing industry in operation there would be automatically eliminated.

The All-Around Vegetable

The Many Uses of the Sweet Potato, and How to Make the Most of Them

By S. R. Winters

THE 1921 sweet potato crop for the entire United States—accepting the July forecast of the Bureau of Crop Estimates—is sufficient to produce approximately 200,000,000 gallons of syrup—a volume suggesting a revision of the Biblical phrase, "a land flowing in milk and honey," to that of a soil drenched in sweet potato syrup The figure of speech is particularly applicable to the South, where nearly 90 per cent of the juicy yams' are grown Alabama Georgia, North Carolina Mississippi Texas and Louisiana—in the order named, are the principal sweet potato producing states—each harvest from 8,000,000 to 18,000,000 bushels annually

Of course the supposition that 112,023,000 bushels of potatoes will be converted into syrup is but a fantasy—a flight of imagination! The sweet potato lends itself to a variety of uses—in fact, an instructor in a negro college in Alabama recently testified before a Congressional committee that this southern vegetable food was being used in 100 ways With out attaching credence or disputing this claim, there is no gainsaying of the flexibility of this underground root crop whose spreading vines literally dot the South land And sweet potato syrup is the latest addition to its constantly expanding uses A process developed by H C Gore chemist-in-charge, fruit and vegetable utilization laboratory of Bureau of Chemistry United States Department of Agriculture, makes possible the manufacture of sweet potato syrup both in the home and factory A production unit, recently established by the Government at Fitzgerald, Ga, will determine the feasibility of the commercial application of the process The initial experimental run of the factory machinery yielded 600 gallons of syrup and the costs of producing and marketing the product are being studied Meanwhile, Southern homes can apply the process to effect in extracting table syrup from the humble tuber

The recipe for preparing the liquid sweetening on farms has been successfully established by laboratory experiments The original formula, however, as announced a few months ago, has been modified by subsequent determinations of the Bureau of Chemistry The modification of the method of preparation is in the interest of a well flavored product. The use of malt made from barley or wheat is somewhat restricted by the amended process inasmuch as the sweet potato has disclosed certain contents which enable it to digest its own starch Yet, a limited quantity of malt can be employed to advantage The potatoes are boiled until soft, stirred until they form a smooth pulp, water added, the proper temperature insured, and by incorporating a limited quantity of malt, which stands for a brief period the starch in the potatoes is converted into maltose sugar and dextrin On pressing the wort or the material in a state of fermentation these soluble solids, together with the reducing sugars originally present in the tubers, are readily divorced from the pomace

The numerous commercial varieties of sweet potatoes are adaptable to syrup-making the color varying with the kind of potato For instance, white varieties like Southern Queen yield a light colored fluid while the Porto Rico and similar assortments produce syrups somewhat darker in color Stored as well as freshly dug tubers lend themselves to the production of the sweetening fluid—not as sweet, however, as maple or cane syrups. The intensity of the sugarness of the sweet potato product, may it be said here, is altogether satisfactory for many uses. The size of the underground root is irrelevant as far as the quality of the syrup is concerned Herein according to claims of the Department of Agriculture, lies the immense possibility of commercializing the newly-evolved process Frequently forty per cent of the South's potato crop exceeds the prescribed standards of Northern markets in size, thereby rendering them well nigh valueless for shipment. These over grown tubers as well as ones dwarfed in growth, yield sweetening juice equal in quality to standard market grades. Soundness is the one absolute requisite for potatoes designed for syrup-making—decaying portions, diseased tubers and other inflicted faults must be discarded

The syrup and the dried pomace from a bushel of sweets

More about the method of preparing the syrup The potatoes are washed and hand trimmed by way of removing dirt, bruises, and decayed portions The tubers are then blanched (parboiled) either in boiling water or steam Blanching, preferable to peeling, serves the purpose of removing the ingredients in the peel which would impart a green or brown color to the syrup and an objectionable flavor The potatoes are submerged in hot water in a suitable vessel and the water quickly heated to the boiling point. A few minutes having elapsed, the water is drained off and replaced with a fresh supply The potatoes are then cooked until thoroughly mushy in boiling water or in steam If the latter method is pursued, the water condensed should be rejected during the first half hour of the cooking period One hour should be allowed for the cooking, a time limitation inviting the cells of the potato to crumble whereby the malt may invade and digest the starch Steam under pressure is unnecessary as the higher temperature does not hasten the cooking of the potato.

Once cooked, the mushy tubers are scrambled into a paste This is accomplished by stirring, adding water until the contents of the vessel constitutes a smooth thin pulp About two parts of water to one of potatoes is a correct proportion. The mixture is then brought to a temperature of 140 degrees Fahrenheit, a condition suggesting the introduction of the malt. One per cent of pale distillers' malt, made from barley or wheat, based on original weight of the potatoes, is added and thoroughly incorporated into the pulp and mixture, which now assumes the term "mash." It is allowed to stand, with an occasional insertion of the stirring rod While 140 degrees Fahrenheit is an expressed preference, the temperature range is liberal—varying from 129 to 145 degrees Fahrenheit, without deteriorating effects. At this juncture the starchy contents of the potatoes are devoured by the malt, the process requiring from twenty minutes to one hour What scientists term as the iodine test will determine the completion of this reaction, namely. A small glass funnel is equipped with filter paper and a bit of the pulp placed on the filter. When the filtrate runs clear the drops are permitted to fall into a test tube containing a dilute—pale yellow, cold solution of iodine in potassium iodide Each drop as it enters the solution forms a deep blue color As the reaction with malt progresses, succeeding tests yield purple, brown, and yellow brown colors—and, ultimately are colorless. The starch-consuming process is complete, and thus the end of the mashing period is marked.

The mash drains without difficulty, and thus lends itself to a variety of separation methods. The simplest, however, is the rack and-cloth system, well known on farms in the preparation of fruit juices. The pulp is laid up in the form of flat cakes between wooden racks, permitted to drain, and finally pressed. The equipment employed by the Bureau of Chemistry, and illustrated by the photographs which accompany this article, consisted of a screw press, a large pan of sheet tin, forming the floor of the press platform, a set of wooden racks, a wooden form for laying up the pulp; and press cloths of burlap or duck The construction of a so-called "cheese" involves the laying of a rack on the drainage platform. The form is placed thereon and the cloth put diagonally across the form, the corners being opposite the sides. The mash is poured into this depressed "valley," and the four corners of the cloth folded over so as completely to envelop the mash The form is lifted and another rack placed on top The form is again put in position and another cake of mash laid up The operation is repeated until the pile is as high as desired. Meanwhile the wort or sweet portion of the malt flows off without applying pressure other than its own heaviness. Slight force will yield a big volume of wort, while heavy pressure is ultimately resorted to The material while in a state of fermentation is subject to visitation from microorganisms which multiply rapidly in racks, cloths and pressure platforms. The pressing equipment should be dried or kept under water when not in use, otherwise objectionable flavors may be transmitted to the syrup.

The sweetening fluid is now ready for table and culinary use, for manufacturing candy and as a mixing syrup. Its beautiful color is brought forth by filtering, which may be accomplished by allowing the product to stand for a day or a sufficient period of time for insoluble salts to form Then mix about three per cent of the weight of the syrup of what is chemically known as kieselguhr and cold water adequate to easy filtration. The mixture is filtered cold as heating has a tendency to cause the concentrated salts to dissolve and make their appearance in the syrup. A plate-and-frame filter press will accomplish the job. If the raw potatoes are of first-rate quality objectionable flavors will not be present, otherwise off-flavors may appear. These can be removed by adding to the syrup somewhat diluted with water three per

Sweet potatoes, ginger snaps and taffy are all improved by a dash of sweet potato syrup from the bottle

cent of its weight of powdered bone char or other decoloring carbon. The mixture is heated to boiling point, permitted to stand for several minutes and the char removed by filtration. The sweetened liquid is then evaporated to the necessary density.

The yield of syrup is equal to one-third of the weight of the potatoes entering into its composition. The cost of manufacture is relatively low, and the method of preparation in home and factory is comparatively simple. The final product is an amber-colored syrup possessing a distinctive flavor — not as sweet as maple or cane syrups, to be sure. The intensity of its sweetness, however, is sufficient for a multitude of uses. Then, too, the conversion of sweet potatoes into syrup offers a big possibility in the tuber-producing South, where markets are frequently far-removed and storage facilities inadequate. All thanks to a chemical process of such transforming powers—an uncouth underground root becomes a table delicacy and contributes to the relish of gingersnaps and taffy! The various pieces of apparatus employed in extracting syrup from sweet potatoes are shown in the accompanying illustration, and one is immediately struck with the simplicity of this process. Indeed, it should come into pretty general use, not only in large sized commercial plants but on the small farm and in the home.

Left: Extracting the "wort" at high pressure. *Right:* Steam-jacketed copper kettle that serves for cooking the potatoes, as a mash tun, and as an evaporator

Apparatus for getting the biggest value out of the sweet potato

Effect of Gasoline Removal on Heat Value of Natural Gas

THE Bureau of Mines, in Technical Paper No 258, presents details of an investigation to determine to what extent the general public and various official bodies have been justified in supposing that the removal of gasoline from natural gas greatly decreases the heating value of the latter. It has been found that in general this decrease in heating value has been overestimated. In the type of gas ordinarily supplied to the domestic consumer loss in heating power was found to be about 2 per cent after the removal of the gasoline vapor. As a rule gasoline vapor is usually accompanied by proportionate amounts of other constituents of high heating value, so that a gas high in gasoline is usually one of high heating value, even after the gasoline has been removed. Where casing head gas is involved the percentage of loss is larger, but only in rare instances does such gas reach the domestic consumer.

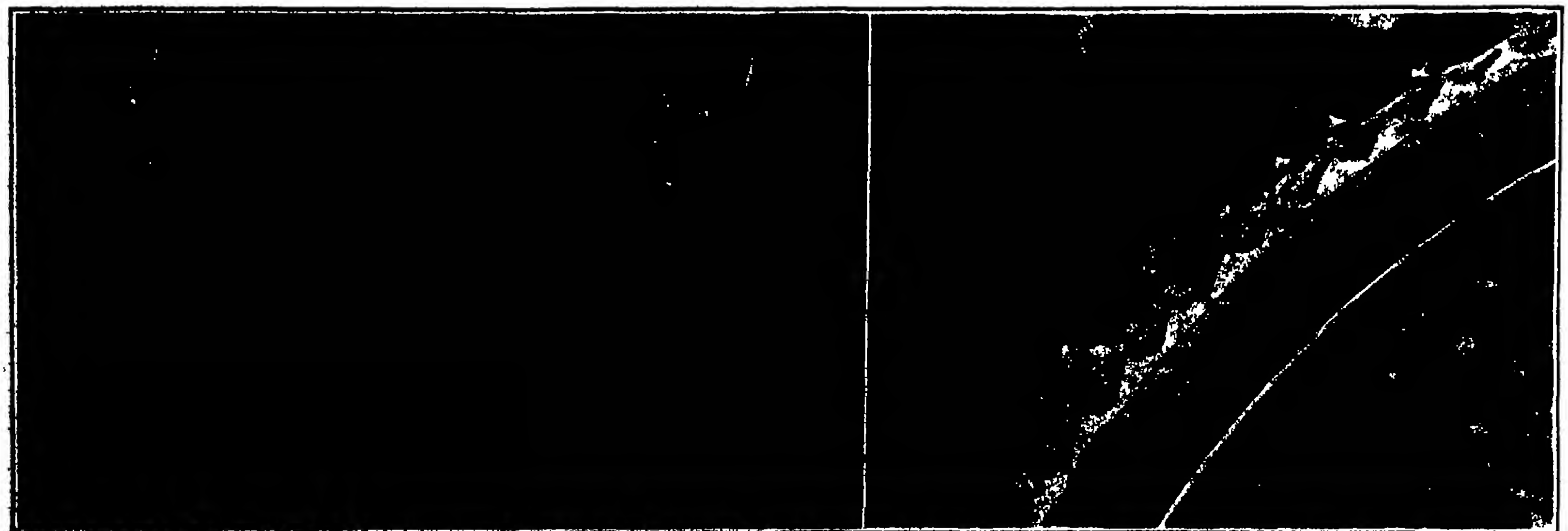
Puncture Plant Protection

IF you can imagine a roadside sprinkled liberally with tacks and needles all lying point side upward, ready to spread discomfort and disaster among the touring motorists and bicyclists which pass that way you will frame a good mental picture of actual conditions existent in sections of Arizona and California where the puncture plant has been introduced and acclimated. Scientifically this weed is known as *Tribulus Terrestris* probably because it spreads tribulation and terror among all owners of inflated tire vehicles. It is a native of southern Europe and was introduced to this country in burs imbedded in the fleeces of imported sheep. When mature the fruits, or burs of the puncture plants split into 5 sections, each of which is equipped with a pair of sharp spines. These sections are scattered about over the ground in such a way that some of the points are always directed upward ready to penetrate and puncture any rubber tires which pass over them.

When the spiny needles of the puncture plant are embedded in automobile tires it is very difficult to locate and remove these destructive bayonets which repeatedly prick holes through different inner tubes as they are inflated in the contaminated casing. The spiny seeds effect a double dose of damage inasmuch as they spread the infection to new sections which previously may have been unacquainted with the obnoxious plant. The seeds may be carried in automobile tires long distances and finally deposited by the roadside where they germinate and produce new plants. In addition, the seeds are disseminated widely by wind rain flood, spring freshet and snow. They often work their ways into the coats of market live stock or else the puncture weeds are harvested with market hay. Recently in one way or another, seeds of the puncture plant have been introduced into Kansas, Arkansas, Texas Nebraska, Iowa Indiana and Illinois and at present the objectionable burs and spiny seeds are causing much havoc among the motorists of those regions. The possibilities for damage from this plant are well illustrated by the experiences of a California motorist who reported 70 punctures in one tire all due to the puncture vine. In some sections where the puncture plant has become established one half of the bicycle tire and approximately one-quarter of the automobile tire punctures result from the spiny burs of this plant which are distributed along the waysides.

Fortunately, the puncture plant is an annual and on tillable ground, it can be controlled by repeated cultivation which prevents the formation of seed. Along the roadsides, where the weeds are most dangerous from the standpoint of the motorists, mowing has been resorted to unsuccessfully as an eradication expedient. The vines grow so low and spread so close to the ground that it is impossible to cut them off satisfactorily with the mower before they form seed. Furthermore, many of the plants which are clipped will subsequently produce burs and seed the same season. The national agricultural authorities are now testing out the effectiveness of iron sulfate and crude oil sprays for destroying the puncture plant. Potentially, they expect to perfect control measures which will minimize the motoring dangers due to the puncture plant, the unwelcome emigrant which reached our shores by stowaway methods.

The illustrations below give an excellent idea of the general appearance of the puncture plant's opening seeds and how they imbed themselves in the soft rubber surface of automobile and bicycle tires.



The puncture plant of Arizona and California, tribulus terrestris, and the way it works destruction upon the unsuspecting motorist

The Economic Aspects of Mobilization

What It Means to a Modern Nation to Put an Army in the Field

By Jennings C. Wise

MOBILIZATION, or the first phase of war, although for an uneconomic purpose, from an economic standpoint should be regarded as a problem involving the translation of potential into kinetic energy. In the process no new force should have to be created. The stored energy should merely require to be converted into a moving force, for time does not permit the generation of new energy after the emergency arises.

Efficiency in warfare cannot be attained without economic efficiency, and there can be no economic efficiency if the economic factors of supply and demand be ignored. Supply in a country possessing so vast and diversified a wealth as that of the United States is largely a matter of transportation, hence it is asserted with confidence that no plan for mobilization is a practical plan which ignores the existing transportation facilities and the problem which their scientific utilization in an emergency presents. Its solution requires the best brains and the best efforts of the Nation, and in that solution every department of Government must be employed, in the future the entire cabinet must act as a General Staff Committee upon mobilization.

The most casual investigation will show that our industrial mobilization was seriously retarded by reason of a complete failure on the part of the Government to provide in advance for the coordination and efficient utilization of our commercial and industrial agencies. Failing to perceive the essential relation between the mobilization of our manpower and industries, an attempt to deal with the former singly and in a detached way, rendered the industrial mobilization for a time impossible. The initial mistake threw the whole country into a state of economic chaos from which it has not yet been extricated. The financial loss which this entailed cannot be computed, some of the more apparent results being the worn-out condition of the railroads, a huge waste upon a non existing emergency fleet, the unnecessary high cost of living, and an enormous and disproportionately increased debt in comparison with that of other countries.

The damage to the railroads resulted from their misuse and abuse, and the disastrous effect upon the economic life of the country from a complete disregard of the economic principles involved in the balance of supply and demand, both of which might have been avoided in large measure.

> *HERETOFORE mobilization has been regarded in this country as a matter wholly within the province of the War Department, but it must now be apparent to everyone that mere segregated aggregations of combatants will no longer suffice for war, and that armies may not be assembled as of yore without serious interference with the social and economic life of the State which furnishes them. Our late experience has taught us that the whole people must now be mobilized along with their material resources. So, too, the time has passed when failure to coordinate the commercial, industrial and military programs merely involved duplication and unnecessary expense. Under the complex social and economic conditions of the present the three must be considered conjointly, not alone for the sake of a saving in money and effort, but in order that the economic organization of the belligerent State may be made to serve efficiently the war machine. In this article, Mr. Wise tells us what this ultimately means.*—THE EDITOR.

The continental territory of the United States may be roughly divided into two areas with respect to industry, food, forage and fuel production and the transportation systems serving it. The first area comprised of the states of Illinois, Michigan, Ohio, Indiana, Pennsylvania, Maryland, Delaware, New Jersey, New York and the New England States is essentially an industrial and non-surplus food, forage and fuel producing area within which are located the vast majority of the manufacturing plants of the country, and at least 95 per cent of those adaptable to munition production. The remaining territory constitutes a vast surplus food, forage and fuel-producing area, non industrial and essentially agricultural in nature and depending upon exportation for the absorption of its surplus production. The economic life of both areas is dependent upon the railway systems within them. The first imports food, fuel and forage from the second, and exports its manufactures to the latter and to foreign markets. The second, while not essentially industrial, is industrially self sustaining, but absolutely dependent for its wealth and economic stability upon the export of its surplus of food, fuel and forage.

At the beginning of the late war despite years of warning, the railroads were not only not prepared to meet the altered circumstances which the emergency of war developed, but were for a time unable to develop their normal industrial capacity. The cause of this breakdown in our National transportation and industrial systems is readily discernible.

In the industrial area the population was suddenly augmented with a consequent increased demand for food, forage and fuel, while the normal supply of these commodities was diminished through the inability of the railroads to handle them, the railroads for the time being wholly employed in the transportation of troops and their supplies. Prices were, therefore, inflated by this disturbance of the economic balance of supply and demand, coupled with which was the wild extravagance of the Government in connection with the labor wage for Government work. Coincidently the draft decreased the supply and the war needs increased the demand for labor.

On the other hand the population of the agricultural area decreased coincidently with an accumulation on the hands of the producers of the normal surplus of food, forage and fuel, exportation being interrupted by the lack of transportation facilities. In this area, the surplus being in excess of exportations, an immediate stringency in ready money occurred, though the wildest speculation was encouraged by the frenzied markets of the industrial area and foreign countries which were willing to pay any price for supplies of food, fuel and forage, thus still further inflating prices. With increasing prices for the necessities the labor wage mounted higher and higher in both sections.

So soon as war was declared, and not before, innumerable agents of the War Department were despatched about the country to select sites for the military cantonments. This was done wholly without regard to any preconceived plan and the limitations of the transportation system of the country as a whole. Congressional political influence played no small part at this time, so that at the very crisis when every provision possible should have been made to relieve the great industrial system of transportation comprised of the railways north of the Potomac and east of the Mississippi River, enormous new populations were deliberately created within that area at Camp Devens, near Boston, Camp Upton and Camp Mills near New York, Camp Dix near Philadelphia and Camp Meade near Baltimore, all within the most complex and intricate industrial region and athwart the most vital link of railway in America.

The natural consequence of the astonishing error was that during the period of readjustment of the railways to the burden of troop transportation and supply, the industries of the East were stalled. Every port on the Atlantic coast immediately became choked, and the entire railway system of the country felt the evil effects of the almost hopeless congestion along the Atlantic Seaboard. No effort whatever was made to relieve the railroads of their excessive burden by an intelligent use of the priceless coastal shipping communication between the Atlantic and Gulf ports for the purposes of troop movements and troop supply.

It almost seems that some perverse fate blinded the Government in the crisis to that which is now clearly apparent. A study of a railroad map will show that within the area east of the Mississippi there are two distinct systems of railroad communications viewed with respect to their origins and termini. The first originating at Chicago and St. Louis, spreads like a net over the industrial area, focusing at New York. This system is essentially industrial, like the area which it serves, and if the Seaboard link between Boston and Washington, or the pulmonary artery of industry, be overstrained the entire system will be paralyzed. This system, then, is vital to industry, and since a complete industrial mobilization is vital to success in war, everything possible should have been done to relieve it of unnecessary burden. Obviously no cantonments should have been created within the industrial area.

The second system originating at Chicago, St. Louis, Memphis, and New Orleans, touches the Atlantic coast at the ports of Jacksonville, Savannah, Charleston, Wilmington and Norfolk, focusing at Petersburg, Va., in the strategically vital region of the lower Chesapeake. The surplus food, forage and fuel producing area within which this vast system lies is wholly separate and apart from the industrial area to the north, yet bound to it by the north and south trunk lines of the Mississippi Valley and the Atlantic Seaboard and the two parallel intervening lines passing southward from Cincinnati. By means of these excellent connections the products and population of the two areas could have been freely interchanged without interruption to the east and west flow of traffic, the entire region beyond the Mississippi being equally accessible to either area by reason of the common bases at Chicago and St. Louis. The east and west lines of the southern system were in no sense essential to the industrial area and, therefore, should have been utilized for the movement and supply of troops. The withdrawal of the military population of the northern area and its distribution in the southern area would have created new markets for the surplus of the latter and at the same time would have counterbalanced the increment to the industrial population.

The advantages of the southern over the northern area with respect to the length of the training season the lower cost of fuel, and the saving of transportation tonnage which is to be effected through the lower fuel requirements of the troops are obvious. It is apparent that the cost of training a given number of men would have been less in the southern than it was in the congested industrial area. With all the cantonments located south of the Potomac and Ohio Rivers, the contingents from New England, the region of New York City and New Jersey, could have been moved southward by coastwise shipping, leaving the rail communications of the Atlantic Seaboard free for industrial purposes, those from western New York and Pennsylvania, from Harrisburg and Pittsburgh, southward via the Norfolk & Western Railroad, those from Illinois, Michigan, Ohio, and Indiana by the Chesapeake & Ohio and its southern connections. Richmond and Petersburgh were the logical points for the distribution of troops along the southern seaboard, by the Southern Railroad, Seaboard Air Line and Atlantic Coast Line. From St. Louis and Cincinnati the more western contingents from the northern area could have been distributed southward. Meantime the entire railway system of the industrial area would have been functioning with its east and west lines free of troops, and without an excessive burden.

The lesson to be derived from our recent experiences is that a mobilization plan must be prepared in advance of mobilization, and this plan must coordinate the commercial, industrial and purely military factors if the best results are to be derived during the war as well as in the days of peace that must follow.

The rail communications between St. Louis and Chicago, Cincinnati and Louisville, Cincinnati and Atlanta, Washington and Richmond, and Philadelphia and the lower Chesapeake must be kept free of fuel traffic, by setting apart the coal fields of Pennsylvania to the northern, and the coal fields of Virginia and West Virginia to the southern area, and the region west of the Mississippi, while the coastal shipping must be so organized as to relieve the north and south rail communications of the Atlantic Seaboard of the maximum burden possible. The food and forage drawn from the grain and beef-producing regions of the west must be introduced into the northern area at Chicago and St. Louis, and into the southern area at St. Louis, Memphis and New Orleans, with Kansas City as the common distributing point. Thus will the problem of mobilization be solved with a minimum of disturbance to and dislocation of the economic life of the country, and a maximum of ease and expedition in the trying days of mobilization.

Rapid Transit Arithmetic

The Principle of the Economic Unit Applied To Large Cities' Utilities

By John Lathrop

WERE the statement printed broadcast in the United States or in Great Britain that "the principle of the economic unit, as applied to construction costs and operation of transit lines in large cities, entailed an inevitable increase of passenger fares," the mass of the people would not understand the meaning of it. And yet, by open and frank discussion—by interpreting this well-known engineering principle so that "the men in the street" could understand it, Lord Ashfield, managing director and Mr Frank Pick, assistant managing director, of the London County tram, underground and 'bus lines, achieved that which might have been regarded as impossible.

The increasing of base fares in the Zone system there from one penny (two cents) to one and one-half pennies (three cents) with virtually no complaint by the people That this was an achievement, that the one-penny base fare was almost so sacred a tradition in England as Magna Charta, the parchment of the original of which rests in the British Museum, must be freely conceded Post-war burdens had been piled on the British people until they staggered under the colossal whole

When, therefore, the suggestion was advanced that transit fares must be increased fifty per cent, else the companies would be compelled to retain the Government guarantee, or be insolvent, loud protest was registered by certain writers who seize every opportunity to prejudice public opinion on all matters in respect of the people's utilities.

However, before these protests assumed considerable volume, the managing director, Lord Ashfield, who is American trained in railway science, asked his assistant managing director, Mr Pick, who also is American-trained, to take up the frank discussion with the people, through legitimate advertising channels, of the precise situation of the companies, explain why increased fares were necessary, and that, unless they were granted, it would be necessary to continue to find financial backing from the Government in order to carry on the service and new commitments essential to continued operation and the supplying of the people s service needs

Mr Pick called in his publicity experts, laid before them the scientific principles involved, and told them to go to the people with their arguments. Preliminary objections publicly expressed had been, as expected among the line of "watered stock," "selfish corporationists, and so forth

The publicity men proceeded, first, to elucidate to the understanding of the average person the practical out-working of the principle of the economic unit They showed how, as a city grows toward a certain magnitude, the economies are preserved, and costs of public utility in construction and operation are reduced per unit They went on to show that, after the city has grown beyond the limit of economic size costs, instead of being lessened per unit, are inevitably increased, that it costs more per passenger to build and operate in a city of a million population than in one of a hundred thousand, and that when population mounts to the six millions of London or New York, the economic limit has long since been passed, and costs per unit are vastly more than when the city was small The involvement of the mechanical works—the intricate net work of pipes, conduits, sewers, watermains, telegraph and telephone wires, the heavy and permanent pavements—entailed inseparably higher costs The growing congestion in the streets, especially after the popularization of the automobile, likewise prevented the economies which the mass of the people believed were possible in a larger city, and added to the passenger mile costs of operation The general increase of cost of supplies and materials, they showed, was 150 per cent For instance, cars which cost two thousand pounds pre-war now cost seventy five hundred pounds—an increase of 275 per cent. And so on *ad finitum*

The arrangement was effected with the Minister of Transport that on September 20, 1920, the Government guarantee should be abandoned the fares be increased from one-penny base to one and a half pennies, and the companies would stand on their own footing financially, meeting their charges from their own revenues, and asking no aid from the public treasury

I talked with Mr Pick at the companies headquarters in Electric House Westminster after the report had been prepared by Lord Ashfield for submission to his stockholders. 'How extensive was the volume of protest' I asked

"We have here, he answered pointing toward the letter files, 'every written protest which we received I should be glad to show them to you There are six millions of persons in London district served by our lines And we received exactly forty two letters of protest'

That, of course, was negligible, especially when the total volume of traffic be taken into account as revealed in Lord Ashfield's report

Car miles of the entire system, 179 000,000 an increase of 19,000 000 during the year

Trackage, 758 underground, 105 trams, 124 omnibuses, 524 Passengers carried 1 487,000,000 underground, 404,000,000 trams, 210,000 000 omnibuses, 873,000 000 total increase over previous year 110, 000,000

These increases were forced upon the transit lines by the conditions of city life there which were duplicated in every large city, and in many smaller cities, in all countries during and after the war And with fares remaining at the traditional one-penny base, so Lord Ashfield observed in his annual report, "the very success of transport companies in attracting and creating passenger traffic was a burden to them Since then (the increasing of the fares) the situation has changed radically for the better

This improvement in the financial status of the

(*Continued on page 190*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired

Old Thought and New

To the Editor of the SCIENTIFIC AMERICAN

Professor Eddington appears to assert that there are absolute things as matter, and that force is purely relative, and also that matter is merely a symptom, and the reality is the field of force (Space, Time, and Gravitation, pp 42, 76, 166, 191, *et passim*) Doubtless by a universal theory of relativity as distinguished from the special and the general theory, these discordant positions could be harmonized But it is difficult for the "exoterikoi" to penetrate to the underlying verity

It is vastly amusing to see the materialists (of whom I am one) giving up matter as an ultimate reality In taking perhaps a final leave of this supposititious and degraded entity, it is interesting to consider some of the views entertained of it by men preeminent for power of thought throughout the ages

Plato called a material object a shadow of the real Gorgias of Leontinum went him one better, and asserted it to be a particular instance of that which is not. Heraclitus before him an example of generation and corruption, of a passing from not being through being to not-being again Democritus, a fortuitous, or necessitated, or self-determined concourse of atoms. St. Augustine, harking back to Heraclitus, a temporality of the Eternal The schoolmen, a group of transitory, varying accidents inhering in a perdurable, unchanging hypostasis. Berkeley, a group of 'visible and tangible phenomena not manifested by an underlying substance Descartes, an extended, inert entity occupying space. Leibnitz, a congeries of unextended, energizing monads Spinoza, a modification of the divine substance Kano, a manifold of intuition. Hegel, a figment of the consutient. Hamilton, a mode of the unconditioned. Mill, a permanent possibility of sensation. Spencer, a manifestation of the unknowable. Emerson, a projected phenomenon of the intellect. Francis Bowen, a locally limited portion of space endowed with the principle of causation. This last would seem to include the latter day view, the nucleus of a gravitational field

Present opinion seems to be that our notions of space and time are derived from our experience personal and ancestral of material objects Of space and time all possible views have been held none of them free from very grave difficulties They are things, objective realities, conditioning all other realities They are relations between things. They are relations between things and states of consciousness (forms of intuition) They are *entia rationis* figments of the reason as distinguished from figments of the imagination. I should think some of the absolute idealists must hold them to be relations between states of consciousness.

It is very early to predict that the latest theory will give the final victory to a modification of one of these views It seems to me that the space-time continuum is needed, not as a relation, but as a correlative of the discretum, the changing material universe

Ashland, Mass. W O ROSE.

An X-Ray Innovation

To the Editor of the SCIENTIFIC AMERICAN

While experimenting in an effort to X ray or radiograph documents and objects of a like nature, we have made a rather interesting discovery, the product of which we have designated as "Flurographs."

The original negatives were made by placing the check or other document between two fluorescent screens while in contact with an unexposed X ray film An X ray exposure of this combination which was tightly clamped in a light-proof cassette was then made with the resulting negatives Development of the exposed film was the routine development for X ray exposures as made in the medical laboratory

At first it was thought that a true radiograph had been made of the exposed document but further experiment demonstrated that the best negatives were made by means of an X-ray exposure entirely too intense and penetrating for such a slight object as a sheet of paper Endeavors to X ray documents without the use of the double fluorescent screens, which in medical work are used simply to intensify the action of the X ray and thus shorten the time of exposure, were entirely without result. We finally came to the conclusion that these negatives were produced entirely by the action of the fluorescent light set up in the intensifying screens which were in turn activated by the recognized action of the X rays upon their structure

Blurring of certain portions of the samples submitted is due to our inability as yet to obtain a holding cassette with sufficient compression to secure perfect apposition of the document and the film Contrast between the paper and the printing can be further intensified by refinement of the technic of X ray exposure These films were taken with an exposure of 20 milliamperes, an intensity of current represented by an air spark gap of 4½ inches, distance of 36 inches and time of ¼ second

Practical uses of this process may include commercial reproduction of documents and other papers, the detection of changes in checks and bank notes and a means of measuring and standardizing the fluorescent action of intensifying screens

Portland, Ore DR. J A. VAN BRAKLE.

Poles and Miles

To the Editor of the SCIENTIFIC AMERICAN

In your Correspondence for August 27, a writer mentioned timing a train with a watch and it occurred to me that the rule for obtaining the speed of a train direct from the watch without any calculation would probably be of interest to your readers.

This rule is very simple and still very accurate *Note the spacing of the telegraph poles.* They are usually 34 to the mile Watch for a straight stretch Count the poles that you pass in 106 seconds, the number of poles will be the number of miles per hour that you are going

This rule was developed from the old 'count the rails' method that is absolutely useless for taking high speeds. The germ of the idea is the same, however, though it is much easier to see the poles than to hear the 'clicks"

Both methods depend on a knowledge of the lengths of the elements. Where mile posts are marked the spacing is easily and quickly found Should the spacing be other than 34 the number 106 must be changed accordingly This is easily done by finding the number of poles in two miles, and then finding the number of seconds it will take to pass 60 poles at a speed of 60 miles per hour For example, 30 poles per mile, 60 poles in 2 miles. It will take 120 seconds to pass 60 poles at 60 miles per hour, therefore use 120 instead of 106 and read the poles as miles as before

Buffalo, N Y ROGER J SWEET

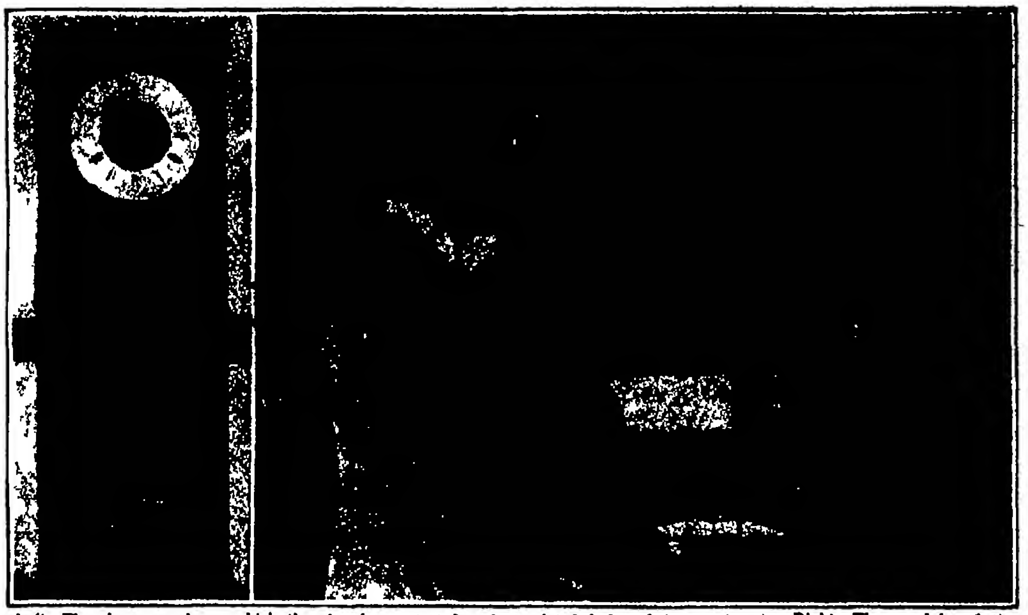
From Star to Chronometer via Radio

The Function and the Manner of Transmission of the Modern Time Signal

By C. H. Claudy

IT is a curiosity of scientific progress that the discovery which makes a new art possible is so often discarded as the art progresses the warping wing which was the basis of the Wright's flying machine, and which made mechanical flight possible, is not now used the Gallilean telescope is no longer in the armory of the astronomer, and the chronometer which with the sextant, made the science of modern navigation possible is rapidly becoming more a convenience than a necessity

The warping wing gave way to the most simple and easily controllable aileron Gallileo s concave eyepiece was displaced by the modern high power convex optical combination, and while accurate basic meridian time is just as essential to longitude determinations now as then, the chronometer gives it to ships at sea with neither the convenience nor the accuracy of the all but instantaneous radio



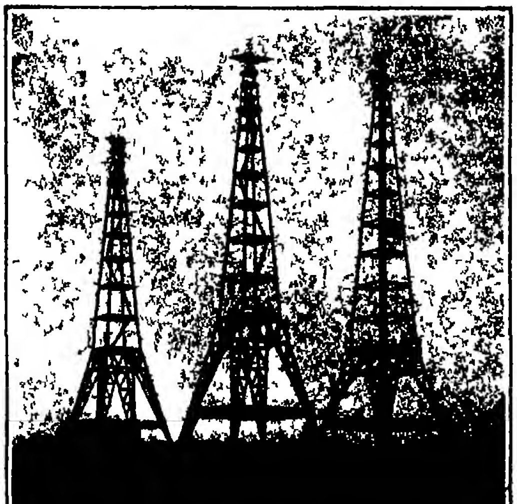
Left The chronograph on which the signals are tested and regulated before being sent out. *Right:* The pendulu of the transmitting clock with the magnet beneath it

Making sure that the time signals beat true second

The United States Navy has developed the transmission of the basic meridian time by means of radio to a point where it is not only used by every mariner in the northern hemisphere who has a radio set upon his vessel, but to the great convenience of surveyors, jewelers amateur radio operators, astronomers and scientific workers of many kinds, including, of course, those engaged in the accurate determination of longitude on land

Easily to comprehend the system by which Washington or Mare Island time is sent out twice daily *via* radio, it will be necessary to glance briefly at the familiar process by which time has been sent out over land wires for many years

The basis of time is the revolution of the earth about its axis, which revolution is measured by a never-ending series of observations of time stars, through a transit or meridian circle instrument At the Naval Observatory at Washington and the Time Station, Mare Island Navy Yard, California there are most accurately made and carefully guarded standard clocks, set on heavy concrete pillars in vaults beneath the surface of the earth running in a partial vacuum at a constant temperature, wound every thirty seconds by electricity, provided with pendulums of invar (which neither expand nor contract) and removed from jar or disturbing influence of any kind



The towers of the Arlington Station

Man has never yet been able to construct a mechanism which keeps truly accurate time, some error, no matter how small, is always observable in a sufficient time to allow that error to accumulate But he has been able to construct mechanisms the error in true time of which is reasonably constant This error, plus or minus, is known as the "rate" of the clock or chronometer, and if the true "rate" of any time-keeping mechanism is known, substraction or addition will give the true time It is to determine the rate, and its changes, if any, that continuous observations are made on clock stars every clear night at Washington and Mare Island Navy Yard

By arrangement with the telegraph companies, their wires are cleared of all other business at five minutes of noon every day, in order to permit the sending of time signals. These signals are sent as a beat, every second omitting the 29th second and last five seconds of every minute, and a wait of ten seconds just prior to noon

The time is taken from the standard clock and put upon the wires by means of a transmitting clock, a mechanism which is but a fine clock movement, designed to make an electrical contact on the beginning of each second, and with an interesting apparatus, to be described in a moment, by means of which it may be slowed or speeded up

Shortly before the time signals are to be sent out, the standard clock and the signal sending clock are both thrown into circuits with recording pens upon a chronograph The simultaneous record of the second beats of both clocks shows immediately how much off the true beat is the transmitting clock Immediately beneath the pendulum of the transmitting clock is an electric magnet through which current may be passed in either direction One polarity adds to the pull of gravity the additional pull of a magnetic attraction, the other polarity will subtract from the gravitational pull a magnetic repulsion. The effect of the one is to accelerate the clock by four one-hundredths of a second (about) in a minute's use of the magnet, the effect of the other is to retard the clock by a similar amount. By use of this delicate retarding or accelerating device the operator is able exactly to synchronize the sending clock and the time clock The signal transmitting clock is connected with the wires at five minutes before noon and beats out the seconds for all the country east of the Rocky Mountains. A similar service is performed for the Far West by the Mare Island apparatus.

The same signals are sent out to the greater parts of the world by means of radio. Radio time signals are sent twice a day, at noon and at 10 P. M. (Washington time) They are to be heard anywhere on the Atlantic or Pacific north of the equator and to an unknown mileage south of it, depending upon the atmospheric and electric conditions, the deficency of the receiving apparatus, the orientation with the radio wave of the receiving antenna, etc. It is thus that ships are made independent of their chronometers.

The determination of longitude is the determination of the difference between local time and time of some other locality. The world uses Greenwich, England (0 Meridian) as the standard. The navigator determines his local time by a sextant observation of the sun, a star or a planet, marking the time of the observation by his timepiece which he compares with his chronometers. His chronometers allowing for known errors give him Greenwich time. The difference between the local and Greenwich time is his longitude, each hour being equivalent to fifteen degrees, each four minutes' difference one degree, etc.

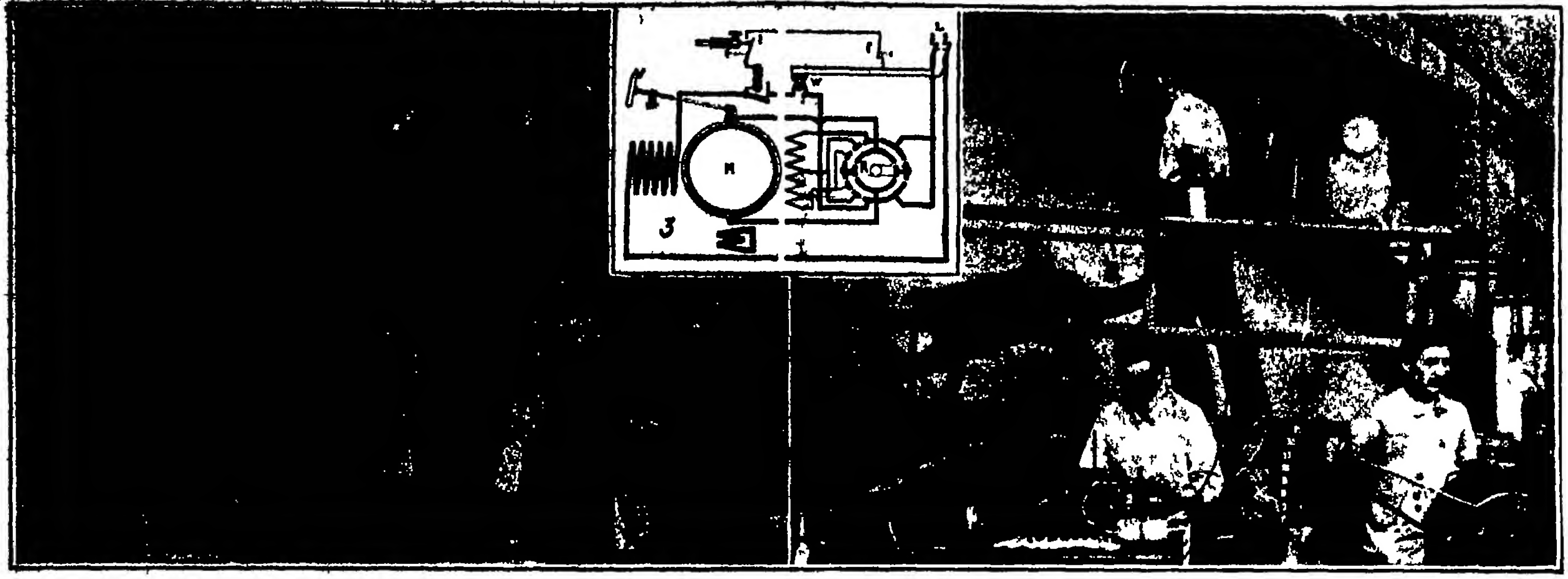
The importance of accurate meridian time on shipboard is vital If the chronometer is "out" the reckoning is also "out" and a ship which doesn't know where she is may be, often is, in deadly danger When ships depend upon chronometer time, three are carried, if dependence is placed in but one there is no way of telling if it varies, if two are carried and one varies there is no way of telling which one, but three tell tales upon each other Even three, or any number of the chronometers, however, may fall into error, and no matter how accurately they are made or how carefully compared and rated on shore, the movement of the vessel in the waves, changes of temperature and barometric pressure the vibration of the hull due to machinery may, and often do, introduce disturbances in the rate In a long voyage the errors in the rate may be material.

But with a twice-daily radio time service, the chronometer, from being the very heart of the ship, becomes of little more service than a first-class watch It is a poor time-keeping mechanism indeed which will not run with reasonable accuracy for a few hours, and with true Greenwich time received twice a day, that is all the navigator demands of his chronometers.

Radio time signals are sent out not from one or two but from fourteen stations. These are Washington, Annapolis, Key West, New Orleans, Balboa, Colon,

(*Continued on page 192*)

The Naval Observatory Building



Left: General view of the man-testing apparatus developed by Prof Langlois as it appears during a test. *Right:* Near view of the moving platform during a test to determine the energy expended in pushing a wheelbarrow up a slight grade. Note the devices for testing the lung action on the shelf to the rear of the subject, and the sensitive devices for making graphs on smoked cylinders in the left foreground *Insert:* Wiring diagram of the electric motor which drives the moving platform

General view and some details of the man-testing equipment used by Professor Langlois

Testing the Human Machine in the Man-Testing Laboratory

SIMPLE as the art of walking appears when one has become proficient in it, it is really quite a complex function from the point of view of the physiologist. Not only muscles, bones, and tendons are concerned in it, but such other factors as the condition of the heart and arteries, the rapidity and depth of the act of respiration, and the coordination of muscles which depends upon the smooth action of the reflex nervous system.

The usual method of observation has consisted in causing the person examined to walk for a definite distance, stopping from time to time so that the examiner may take his temperature and his arterial pressure, and collect a sample of expired air This method, however, is obviously very imperfect. For one thing, under such conditions the subject is not really examined while actually walking, but only during brief resting periods. This makes it difficult if not impossible to study such features as the slowing up or stopping of the motion, the curious phenomenon known as getting a second wind, and the rapid and sometimes violent reactions which take place during the first few seconds after the motion ceases.

Naturally enough it occurred to physiologists that some sort of a device, such as a treadmill enabling the subject to walk without changing his position, would be an improvement.

These considerations led the French physiologist, Professor Langlois, to attempt to construct an apparatus having a variable slope and, at the same time, big enough and strong enough to support the weight of several men, while still flexible enough to permit of considerable variation of rapidity Under the auspices of the French War Department he undertook to have such an apparatus constructed in order that the knowledge of physiological action obtained might be made a basis for the physical training of the men The apparatus is shown in our cover illustration, as well as in the accompanying illustrations.

By the aid of a well known engineer named Hallé, an authority on the escalators or moving platforms used in the big French department stores, he succeeded in devising a suitable apparatus, namely, one in which the velocity can be made to vary within rather wide limits, and with a slope that can be modified so that inclines ranging from 0 to 35 per cent may be obtained Furthermore, the movement may be reversed so that the subject may be examined when walking downward as well as when ascending Again, there are a number of safety devices to prevent all danger

As now in use the escalator or endless platform resembles those commonly used in the department stores, except that it is not used to assist the progress of the person walking but to keep him in the same spot while moving his legs.

The platform is made of chrome leather and is 26 mm. thick; it is formed of leather thongs 25 mm. wide, placed side by side. The carpet is 6 m. long and 60 cm. wide; it is stretched between two wooden drums, 52 cm in diameter, one of which is fixed while the other moves freely The distance between these two drums is 3 18 m from one axis to the other The useful length of the carpet is about 2 80 m

The two bearings of the axle of the freely moving drum are mounted on shoes or sockets and are controlled by two screws which move them backward and forward in the same manner as the screws which regulate the rear wheel of a bicycle This makes it possible not only to regulate the tension of the platform but also to suppress the parallelism of the axes of the two pulleys. A platform so short as this has, of course very little elasticity, and it is impossible to obtain an equal tension of the two edges. This inequality of tension tends to make it slide upon one side of the pulleys, but in order to keep it in place it is only necessary to vary the orientation of the axis of the free drum

Between these two drums the platform rests on a polished oak floor upon which the weight of the subject bears while he walks. At first large quantities of talcum are used to reduce friction, but gradually the two surfaces in contact polish each other so that they slide without difficulty The carpet is drawn along by the fixed drum wedged upon a shaft which rests upon two stout bearings A 5-horsepower electric motor, shown at the right of both illustrations, drives the moving platform in the reverse direction to the walking subject.

The electric motor is connected in series and its functioning is analogous to that of a series motor operating on direct current. In this instance single-phase alternating current is employed, together with a brush and commutator arrangement which may be varied to permit of a wide range of speeds The motor is of the four pole design. Its fixed portion bears two windings, the first is closed in a short circuit upon itself, its axis following the normal direction of the line of the brushes, while it acts as a compensation for the field of the induced current The second winding, whose axis is perpendicular to the line of the brushes, serves to start the motor, it is mounted in series with the induced current The speed is regulated by means of a hand wheel on the frame of the motor The subject of the experiment can stop the motion of the apparatus merely by pulling backward the right hand rail

A wattmeter shows the power absorbed by the motor, a tachymeter gives the speed of the motion of the carpet, and the degree of inclination of the apparatus is indicated by an arrow moving over a graduated dial.

The efficiency of the human machine is comparatively high, we learn from Professor Langlois' experiments, amounting to 33 per cent in well trained individuals But we must consider not efficiency alone, but the effect on the body, and here the heart action is significant. The Langlois apparatus enables us for the first time to obtain a record during the very act of walking, of the rhythm of the heart and of the blood pressure, we can observe further the increase of temperature variations in the state of the tremors of the body, and even (by X-rays) the form of the organs, especially the contraction and expansion of the heart during the exercise

Professor Langlois experiments are specially meant for the purpose of studying soldiers, students, and laborers. They will answer such questions, for example, as whether the greatest efficiency can be had by pushing or by dragging a load, and what is the most economic load for a man of given height and weight, for a given slope, etc

Trucking Milk Long Distances Without Spoilage and at Lower Cost

A SAN FRANCISCO milk distributor, reaching far back into the country to obtain an adequate supply, found that the success of the enterprise turned on transportation The railroad was used at first, but the carrier could furnish only baggage cars which had ventilators in the forward ends What with heat, and bacteria the milk arrived in poor condition From the shipping point, Soledad, to San Francisco, was 134 miles, and though no Coast distributor had ever trucked milk that far, the company decided to try it

Solving certain serious problems, the distributor put the enterprise over with all round success

The first, and most serious problem, was the churning of milk in the tanks. There would be so much of this over the long route that city milk inspectors declared the milk would arrive unfit for sale. They were so certain on this point that they were right on hand to inspect initial shipments.

The company mixed and cooled the milk at Soledad to a temperature of 36 to 40 degrees On arrival in San Francisco, even in the hottest weather its temperature was not greater than 45 to 48 degrees. Thus the milk throughout the route was kept too cold to churn or spoil The maintenance of the temperature throughout a long trip—one truck used takes 10½ hours the other about 12 hours—was accomplished by covering the ten-gallon milk tanks with three layers of wet sacks, and throwing a tarpaulin over all The sacks are wet as required en route

As suggested this was the greatest obstacle to truck haulage Another difficulty was caused by a feature of the route, the San Juan grade, crooked and steep The trucks carry large loads. One truck's average load is 278 10-gallon tanks, the other's 200 tanks. Trailers are used The problem of the San Juan grade was solved by employing a 2½ ton truck, stationed at Salinas, to haul the trailer to the top of the grade each day

Under the particular conditions, the truck method actually effects a minimum 20 per cent saving in transportation cost, to say nothing of the milk arriving in better condition The railroad charge was 50 cents a tank. Figuring all charges of labor, gasoline, depreciation, the distributor figures 40 cents as the maximum cost with truck. On every day's load of milk transported there is a saving of $28 made

The milk is collected from the producers at Soledad by small trucks. The big trucks leave for Frisco around noon.

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Cooperative Analysis

THE American Oil Chemists Society has issued a co-operative analytical program for 1921-1922. The purpose of the work in question is to provide reliable means to assist chemists in discovering to what extent their organizations are working with accuracy, and in case accuracy is deteriorating, to locate and eradicate the cause. This same purpose is accomplished in some other industries by the use of standard samples such as the standard iron and steel samples supplied by the Bureau of Standards. The materials with which the oil chemist works being unstable, cannot be standardized in the same way and so the society is undertaking another method of standardization which seems to satisfy the requirements. No labor or expense is spared in preparing uniform samples, and in years past more than one hundred analysts have collaborated in the work. The sample groups include meal fertilizer, fat samples, and crude oil. Standard methods of analysis are followed and the samples are sent out at stated predetermined intervals to all those cooperating in the program. At the completion of the work suitable recognition will be made for meritorious work. The analyst whose total average efficiency on the forty meal samples for both oil and ammonia is highest will be awarded the silver laboratory cup. In addition to this certain certificates will be given for meritorious work in the other groups.

The society for the past six years has conducted collaborative work on the analysis of meals heretofore known as the check meal work but this is the first year that the activity has been extended and a booklet has been issued for the purpose of interesting as large a number of analysts as possible.

Preventing Mold and Decay in Wood Pulp

SERIOUS losses are caused in wood pulp during storage due to mold and decay which condition has led the Forest Products Laboratory to undertake experiments to determine the relative suitability of preservatives which might be used to prevent these losses. In considering preservatives, account was taken of their effectiveness as antiseptics, poisonous properties, tendency to discolor the pulp, objectionable odor, solubility in cold water and cheapness. All in all sodium fluoride appeared to give the best results, and a 5 per cent solution sprayed on the pulp at the rate of eighty pounds of dried salt to a ton of air dried pulp kept it practically clean for a year. A 3 per cent solution permitted only a slight molding. Among the other compounds tried were borax, boracic acid, sodium dinitrophenolate, sodium bichromate, sodium carbonate and bicarbonate.

Coloring Gems

AT the Reno Station of the Bureau of Mines where special attention is given to rare and precious metals it has been found that colorless gem stones may be temporarily colored through exposure to radium emanation. A colorless Colorado topaz was tinted yellow by such exposure though this color was not permanent when afterward exposed to light. It is too early to predict what the outcome of this discovery may be and further work has been undertaken looking toward making such coloration permanent. Should this prove successful it would be possible greatly to increase the commercial value of many of the gem stones now found in the West but at present considered of low value because of the lack of color.

Reports of the Progress of Applied Chemistry

THIS is a volume issued by The Society of Chemical Industry and Vol 5 for 1920 is just now available. It is an interesting collection of twenty five reports, each by one or more specialists who have reviewed the progress of applied chemistry in their own special field for the year 1920. It is to be recommended to all those even remotely interested in the subject, for the reports are not too technical to be read with interest by the non technical reader.

In the chapter on gas, destructive distillation, and tar products, we find that H. E. Wright considers that coke oven regenerating settings give 6000 cubic feet of surplus gas per ton of coal as surplus. For town supply this surplus coke oven gas is considered superior, from the economic standpoint, to the gas supplied by the present gas works system. The chief trouble anticipated in the use of surplus gas is in the supply of constant quality. For this reason double mains are advocated for separating the rich and poor gas, as the former only would be used for domestic purposes. In most localities little effort has so far been made to use such surplus gas.

Another author in commenting upon the advantages which would accrue from the use of cheap oxygen in metallurgical operations suggests that perhaps the solution for the problem of storing hydroelectric energy lies not in the perfection of lighter weight and cheaper storage batteries than we now have, but in the use of the current for the production of hydrogen and oxygen. These gases could be stored without difficulty and used in established processes as well as many others which would certainly be developed if there were large quantities of such gases available at a low price.

Those who have seen the experiment of breaking a wine glass by striking the proper note on a violin will be interested in a method patented by H. Püning for removing dust from the settling surfaces employed in electrostatic precipitation. The method consists in the use of a whistle or siren by which sound waves of sufficient intensity to cause dislodgment are set up. There have been other examples of the force of such sound waves as, for example, in range finders where it has been necessary to place diaphragms so that sound waves set up by the firing of the guns might be so broken as to prevent their causing the breakage of taut piano wires upon which the optical systems are mounted within the protecting metal tube.

It is not surprising to find little reference to research in America on matters pertaining to fabrics, for, as is well known, our textile industry is one of those which thus far have not been convinced of the advantages to be gained through the application of science to the industry. In Germany, a prize of twenty thousand marks has been offered for a method of ascertaining the end point in the retting of bast fibers and further prizes for a method of avoiding the objectionable odor and injurious nature of the effluent from the retting processes. Still other prizes are offered for a practical method of artificially drying retted flax and hemp.

Agricultural Insecticides

R. H. HENDERSON in the June *Chemical Age* (New York) discusses raw materials and methods of manufacture of the principal agricultural insecticides. Insecticides and fungicides have been increasing of recent years and by the application of colloidal chemistry and other advanced sciences many improvements have been made. Arsenic acid is perhaps the principal ingredient in insecticides. Some years ago certain smelters stated that when arsenic would be worth two cents a pound they could afford to save it but not otherwise. Last year it sold as high as seventeen cents a pound although at present the price is about one-third that figure. Its principal sources are the United States, Canada and Japan.

Lead and lime are other important base materials and sulfur is used as such as well as in certain combinations. Tobacco in the form of scraps, stems and sweepings are used after a reduction to fine powder for dusting and as raw materials in the preparation of nicotine solutions and nicotine sulfate. A number of oils find application as emulsions for plant lice and scale insects. Petroleum and fish oils are the ones principally used. Lime sulfur solution was developed originally for dipping sheep and its usefulness as a spray was discovered when a farmer decided to try his sheep bath mixture on a badly damaged orchard. In an effort to reduce the expense and difficulty of handling liquid lime sulfur research was conducted a few years ago to see whether dry lime sulfur might not be prepared. A certain measure of success was obtained it having been found that if some such material as starch or sugar were first mixed in small percentage with the lime-sulfur solution the mixture could be dried in vacuum. It is interesting to know that the manufacturer who supported the original research has not made use of the results although certain of his competitors have done so. The dry product is not as stable as could be desired and has a tendency to decompose on exposure to air with an increasing percentage becoming insoluble with age.

London purple which was extensively used a number of years ago was originally a by-product of the dye industry and consisted principally of arsenite and arsenate of lime. When the arsenic process for the manufacture of magenta was replaced by the nitro-benzene and synthetic formaldehyde process there were no arsenic by-products for sale. The small amount of London purple now used is specially prepared from waste materials containing arsenic. Even paris green has been largely superseded by arsenates of lead or calcium. Paris green is an aceto-arsenite of copper prepared from copper sulfate, acetic acid, carbonate of soda and white arsenic.

The use of oil emulsions has always been interesting and has involved considerable research in the preparation of certain emulsions. The following is quoted from the article in question.

"These may be prepared in several ways. Soap is dissolved in water and the solution heated. Petroleum oil is then run in and the batch thoroughly mixed and pumped under high pressure through fine spray nozzles. The passage through the spray nozzle causes the formation of a white creamy emulsion.

"Another method is first to mix the petroleum with some form of saponifiable oil as fish oil. A caustic soda solution is then run into the batch, while it is rapidly agitated, in sufficient amount to saponify the fish oil. This also forms a white creamy emulsion.

"Emulsions also may be prepared by mixing sulphonated oils with petroleum. This forms a miscible oil which, on later dilution with water, will form an emulsion.

"Not all petroleum distillates are toxic to insects. In just what portion of the crude petroleum the toxic principle lies has not been investigated thoroughly. Vickery, in the *Journal of Economic Entomology*, states that 'kerosene, particularly in California, sometimes fails unaccountably to kill scale insects.'

"The reason for using the oils in the form of an emulsion is that this renders dilution possible. If the concentrated raw oil were used on plants it would injure them. Recently oil emulsions have been prepared by using certain colloidal materials as emulsifiers. These materials assisted by agitation cause the oil to break up into very fine particles in the watery mixture and finally form a very stable emulsion."

Production of Pure Hydrogen

IN *Comptes Rendus* for April 18, Claude discusses his experiments on the production of hydrogen of sufficient purity and low cost to guarantee the commercial success of his hyper pressure process for the fixation of atmospheric nitrogen in the form of ammonia. Water gas and coal gas must be separated as well as carbon monoxide which is both objectionable and has heretofore been difficult to eliminate completely. Claude makes his separation by applying the principle of the insolubility of hydrogen and the solubility of other gases of the mixture in ether. The mixture is compressed to a given pressure and passed through the solvent at a low temperature. All gases but the hydrogen are dissolved. The solvent is drawn off and when expanding to atmospheric pressure the gases escape, leaving the solvent ready for reuse. After a series of researches it has been found that carbon monoxide can be reduced to a minimum by working at a temperature of 40 degrees below zero and a pressure of about 100 atmospheres. By this method the hydrogen contains less than 0.002 parts of carbon monoxide.

Synthetic Insulation Materials

R. W. KENNEDY in the *Electrical Review* reports tests by the National Physical Laboratory on synthetic insulation materials showing the exceedingly good insulating properties of artificial silks particularly those based on cellulose acetate. These silks have been found superior to ordinary real silk insulation. Coils of iron covered with these materials gave results much in favor of artificial silk under the various conditions of temperature and humidity, especially when such insulation had been given a dip in a solution of cellulose acetate in acetone and chloroform. Such a lacquer of non-inflammable cellulose compound in a volatile solvent has been found satisfactory as an insulating varnish and when formed in sheets as suitable for accumulator cases and for general insulation.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

A simple pipe-bending machine which solves the pipe-bending problems of the small and large shops alike

Facilitating the Bending of Iron Pipe or Tubing

AMONG the latest labor-saving devices is the pipe bender shown in the accompanying illustration, which is designed for bending standard iron pipe or tubing up to 4-inch pipe size

The roller bracket of this machine is adjustable to take forms up to 48 inches in diameter and is operated with eccentric lever to force the tube or pipe into a groove or form for holding the outside follower bar close to the tube This is absolutely necessary to secure the best possible results. The machine is operated by lever engaging friction clutch pulleys for forward and reverse drive Adjustable stops are provided to suit any degree of bend required Clutch is automatically thrown out of engagement at both the end of the bending operation and when the machine has been reversed to the starting position

Special forms with inside follower bars or floating mandrels can be furnished for bending light gage tubing to a short radius without flattening or crimping, so it is claimed The pipe is secured to the form by means of strap and eccentric lever and both the inside follower and the form are grooved with the proper thickness to secure the best possible results

Motor-Driven Hair Cutter

A GERMAN barber has invented a simple motor-driven hair cutter, which is shown in the accompanying illustration The 110-volt electric motor drives the hair cutter mechanism through a reduction gearing, and the barber's hand is not fatigued as in the usual hand-operated hair cutters. And it is well to bear in mind that in Germany and other European countries a hair cut is a pretty thorough job, with every hair cut down to almost nothing, as compared with our extravagant and frequent American trims

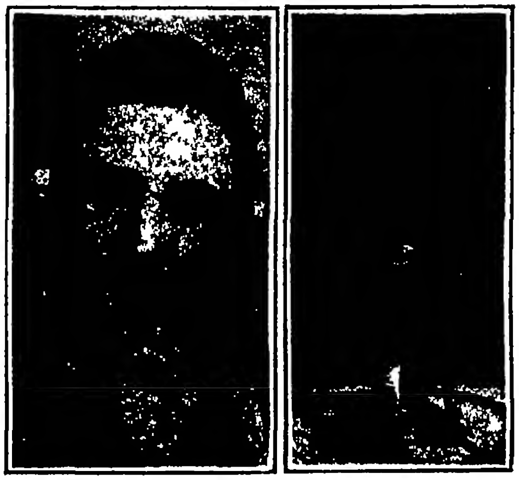
Electrically-operated hair cutter which enables this German barber to save much time and effort

A Face-Grinding Table for the Disk Grinding Machine

TO fill the need for a powerful disk-grinding machine which incorporates a hand feed work table of the face-grinding type, a Wisconsin manufacturer has developed this device The table is particularly useful in grinding large work where heavy cuts are required and also on longer parts such as exhaust manifolds, lawn mower bars machinist's levels, and so on

The sub-slide is adjusted on ways to the position desired and is locked with jib screws. A worm and nut actuates the cross feed slide and the micrometer markings are found on the hand wheel A rack and pinion operates the longitudinal travel of the table top Adjustment is provided so that there is sufficient clearance at the rear side of the grinding wheel

The center of the work to be ground is brought up to the center of the grinding wheel as the fixtures are built at the proper height for this. It is claimed that this type of table lends itself especially to the use of rotating and revolving fixtures



Telephone instrument invented by an American woman, for the purpose of increasing telephone efficiency

Something New in Telephones

DESPITE the fact that we have come to consider the desk type of telephone instrument as a standard it seems that there is room for improvement At any rate, inventors from time to time turn their attentions in the direction of evolving better and more convenient types of telephone instruments with interesting results.

Now it is Miss Katherine Nichols of New York City, who has invented a new type of telephone instrument. Her invention is known as the combination type As shown in one of the accompanying illustrations, it has a double receiver device which excludes all outside noises. It can be picked up and talked into as with the ordinary desk telephone, and the double receiver feature is claimed to increase its efficiency by fully 50 per cent In fact, if anything, this radical departure from American practice is strongly suggestive of European practice, where transmitter and receiver are mounted on one arm so as to be handled together

Reducing the Ammeter to Its Simplest Form

THE ammeter, shown in the accompanying illustration, has been designed primarily to test dry cells and affords the only means of indicating the condition of the cell It is constructed so that contact may be made directly to the battery without the use of a wire lead, but a terminal is provided so that a lead can be used if so desired

A dry cell may be tested with this new ammeter by placing the metal insertions on the back of the instrument, to the terminals of the cell. Each small division on the dial represents two amperes A dry cell of ordinary commercial size when new should register approximately 28 amperes

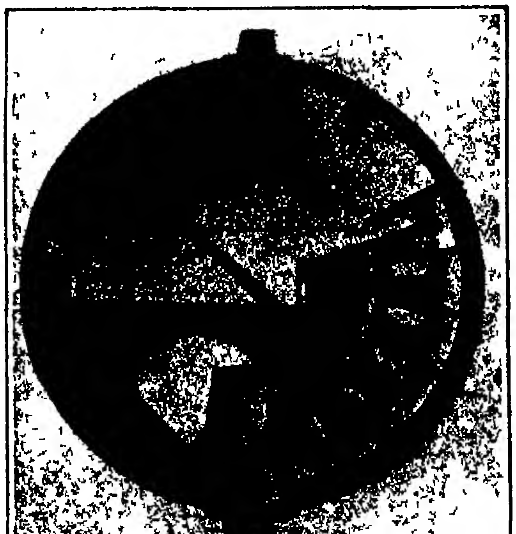
A one-piece aluminum punching serves as the coil or solenoid, as well as the terminals, dial plates, the

The hand-feed work table brings the work up to the face of the grinding wheel and regulates the grinding action

mounting for the armature and the support for the glass The entire collection thus formed is placed in a rubber composition case so as to form an ammeter of the most simple design and construction This unique construction, it is claimed eliminates soldering the screw connections common in other meters, making a more durable dependable and accurate instrument The meter is sealed so that it cannot be opened or tampered with and should give long and satisfactory service The stamped coil or solenoid is the feature of this invention and may be made adaptable to other electrical devices such as relays circuit breakers, indicating instruments transformers, or other appliances that require the use of solenoids and armatures

Uses of Metallic Magnesium

THE addition of half of one per cent of magnesium to castings of copper, brass and aluminum, adds greatly to their strength according to a writer in the *Teknisk Ukeblad* When magnesium is exposed to high pressure steam the surface is oxidized and this oxide can only be removed by heavy hammering The oxide is one of the best insulating materials in existence as a layer 1 mm thick which may be deposited in 15 minutes by exposure to steam of 20 atmospheres, will resist a pressure of 20 000 volts Electrical insulators for high pressure transmission lines requiring great strength and high resistance can therefore be made of this metal or its alloys Magnesium plates treated in this manner have also been found excellent for electric cookers heaters and radiators as the radiating power amounts to 75 per cent of the total heat compared with only 25 to 34 per cent from ordinary metal surfaces. The balance of heat in the latter instance being emitted by convection, is not economical on account of the direction it follows, viz., vertical



Working parts of a newly designed ammeter One stamping serves as the solenoid and other parts

Rapid-Transit Arithmetic

(*Continued from page 185*)

London transit lines was wrought by the increased fares as shown by the following condensation of Lord Ashfield's report

During the first three months of 1920 the underground carried 108,000,000 passengers receiving an average per passenger of 2.5 pence (five cents) During the last three months of the year 96,000,000 passengers for an average of 3 pence (six cents)

In the first three months, the omnibuses carried 217 000 000 passengers for an average fare of 1 75 pence (three and one-half cents) In the last three months, 199 000 000 passengers for an average of 2 5 pence (five cents)

In the first three months the trams carried 51 000 000 passengers for an average of 1 5 pence (three cents) In the last three months, 47 000 000 passengers for an average of two pence (four cents)

It worked out that although on the total year's traffic there was an increase of 110 000 000 passengers the traffic in the last three months was less by 32 000 000 than in the first three months A two per cent decrease in these three months as related to the year's total haulage, plus the fare increase lifted the companies from necessary Government aid to financial independence The people were bound to pay the extra charges in any event, whether indirectly in the form of Government subsidy or directly in the form of increased fares It was not arbitrary action nor was it corporate manipulation which wrought to produce those increased fares in London It was the Median and Persian law of economics—the law of the economic unit—which compelled that result

It is not suggested herein that this purports to be an exhaustion of this subject or even to be a complete syllabus It is merely to descant on the scientific phases of the interesting situation of transit in London it being true that principles fundamental there must be and are fundamental everywhere principles being universal

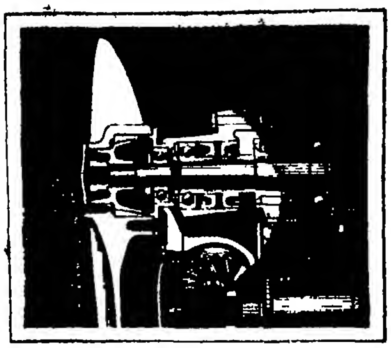
The point of scientific interest in these figures and facts is that there is a general misapprehension by the popular mind of the science of the economic unit—a misapprehension not at all surprising Not only the mass of the people but hosts of otherwise well educated men and women labor under the delusion that the larger the city the smaller the construction and operation costs per unit of public utilities

This delusion was cited to me by the late Mr Theodore N Vail President of the American Telephone and Telegraph Company one day in his offices in New York headquarters Going to a window and pointing downward to workmen engaged in tearing up a street and laboring among the net work of utility accessories he said

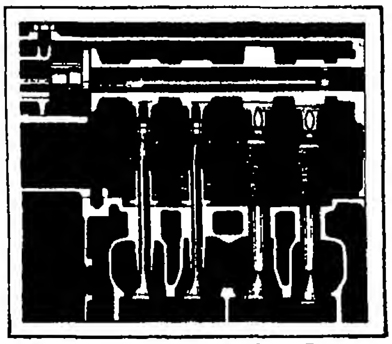
"You are right in applying the principle of the economic unit to this problem It is difficult to explain to the people why the cost of installing and maintaining a telephone increases as the city grows beyond a given economic size Just what that economic size is we cannot precisely define But it is obvious that New York City with its six millions of population has passed it Every movement by workmen is hindered by the presence in the street of the other utility works Every act costs more for that reason Yes it is the principle of the economic unit that explains it—but it is hard to make the people understand it

The President of the Society of Mechanical Engineers of Great Britain, delivering his annual address before that body early this year declared that the cost per passenger mile on the London 'buses was more than one hundred per cent higher than the cost per passenger-mile on the underground Although he did not minutely analyze the statement

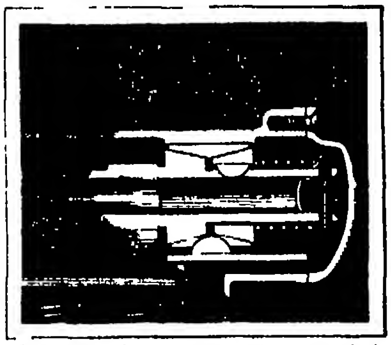
(*Continued on page 198*)



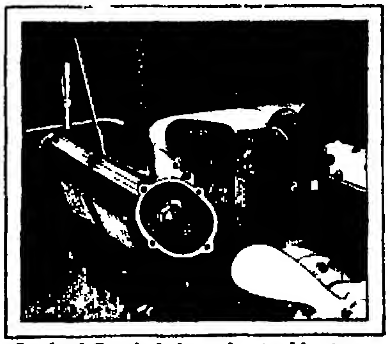
Automatic release of fan clutch when proper cooling speed is reached effects large saving in horsepower



Overhead Valves seat accurately at all temperatures because of scientific skill used in selection of materials



A simple steadying or braking device on end of crankshaft eliminates usual noise



Overhead Camshaft driven by spiral bevel gears and pinion—No chains are used

The Outstanding Feature of the Wills Sainte Claire is its Motor

C. Harold Wills has given to the world a new conception of motor efficiency.

The Wills Sainte Claire motor is of the eight cylinder, twin four type—It is V shaped, set at an angle of 60 degrees in order to eliminate the usual periods of vibration, and has embodied in it many distinctive basic features conceived and developed by Mr. Wills.

Its amazing responsiveness and flexibility—its smooth, silent, vibrationless action, its remarkable power development and its economy of operation all proclaim it one of the great outstanding achievements in the history of motor car engineering But the motor is only one of the striking features of the Wills Sainte Claire

Mo-*lyb*-den-um steel—the new super-steel developed by Mr Wills and used for all load-bearing and driving parts of the car makes possible, lightness of weight combined with great strength, durability and resistance to vibration

The wonderful Mo-*lyb*-den-um springs together with the perfect balance and scientific distribution of weight give the car a wonderful roadability and ease of riding

While the beauty of design and richness of finish give it distinction in any motor car assemblage.

The Wills Sainte Claire is made in four models—5 Passenger Touring Car, 4 Passenger Roadster 4 Passenger Coupe; and 5 Passenger Sedan with 2 extra seats that fold flush into back of front seat

C. H. WILLS & COMPANY
Marysville, Michigan

WILLS SAINTE CLAIRE

Rapid-Transit Arithmetic

(*Continued from page 190*)

it was obvious from the context that it was the intense involvement of the street traffic—the mass of 'buses, trams, automobiles, horse-drawn vehicles and pedestrians in a congested state which entailed the added per passenger-mile charges for operation

I submit that until these scientific truths be elucidated to the people there will be no intelligent public consideration of public utilities. So long as there be unenforced comment, there will be unfortunate prejudice And so long as unscientific ideas prevail among the people the politician with public-favor axes to grind will befog the issue.

If, however, anyone will take the trouble to find the true answer in his own experiences as he moves about in a crowded congested city, he will easily understand this apparently obscure meaning of the principle of the economic unit

His delay at street corners when traffic is flowing past his extra time required to get from his office to call at another office the constant toll of time which he must pay in going from point to point

If he then also the public utility work man, must pay that toll of time, if he, then the public utility itself, must constantly pay the super-charge of time and money in doing business in a very large city and if so, then charges must advance—as a general proposition, and under existing forms of mechanical procedure

No one may foretell what will be true in the distant future It may be that ingenuity will devise methods of overcoming the resistance of intense large-city involvement. But that it has not yet been done must be conceded by all who can see the fact when presented and apply to the utility the principles which he himself applies perforce, every day he lives in and does business in one of the world's metropolises

From Star to Chronometer via Radio

(*Continued from page 186*)

Cavite (P I) North Head (Wash) Eureka (Cal) Point Arguello (Cal) San Diego, San Francisco, Great Lakes (Ill) and Pearl Harbor (T H) Some of these stations send spark some are signals, and four send both Where two or more stations can be heard simultaneously a large variation in wave length is arranged thus, Washington sends 2500 meters and Annapolis 1700 meters Balboa 7000 meters arc and Colon 1500 meters spark

The accuracy of the time signals as sent and received by radio is of course of extreme importance Determinations of this accuracy are carried out constantly Any navigator assumes, on receiving a radio time signal that he is getting true time, or time which varies from the true time by an amount of which he has been previously warned Washington signals lag behind true time nine hundredths of a second the lag in Annapolis time is 0.07 second These are known errors, which are practically constant. They are caused mechanically by the relays which are in the land line circuits. It is true time which starts from the Observatory transmitting clock, but a relay starts the signal over the wires and another receives it and turns it into the automatic machinery which sends out the radio signal In these relays there is the slight loss of time noted In the Key West signals there is a lag of twenty-eight one-hundredths of a second, due to the larger number of relays between Washington and Key West

The lag however, which is always a *plus* error that is the signal was late in starting and so we must have added to it the amount of the lag to get the true time is not the only error Other causes result in small errors (generally less than a tenth of a second) which are of no real importance to navigators, but which may be of great importance to those who are using time signals for accurate surveying or longitude determinations. A careful check is made of these errors, which are listed by days and amount plus or minus, and such lists are sent out monthly to all who request them, and regularly to such organizations as the Coast Survey, the Bureau of Standards, several watch companies, the Bureau of Railroad Time Service, etc.

The development of radio time signals to be sent out from the United States has reached its maximum as regards the number of sending stations—it is even possible that one or two might be omitted without material injury to the service There is no need to add other stations within the radius in which existing stations can be heard But the radio time service is making constant strides forward in accuracy and in research At present, experiments are being conducted with a view to the elimination of long land lines, such as from Washington to Key West, and sending Key West a radio signal which will there be picked up and automatically be sent out from the Key West Radio Station Such an accomplishment will reduce the present large lag to a very small one

Another development of great interest is the comparison of the radio time signal with the apparatus which sends it. At the Naval Observatory electrical apparatus has been installed which permits a received radio signal to operate a chronograph This results in the most accurate determination of error in a time signal Thus, Washington sends out a time signal, over the wire it is received at Great Lakes and sent out there by radio, Washington receives the radio time signal, and puts it on the chronograph side by side with the record of the same signal as it was sent The comparison is exact and the error can be analyzed and the proper values assigned to lag in relay, and error in signal Signals have been sent to Australia in connection with longitude determinations, and for such a distance the time required for the transmission of the radio wave must be taken into account Radio travels at the speed of light, roughly 186,000 miles a second Australia, half way round the world is roughly 12 000 miles away The signal then requires about 1/15 of a second plus, to travel the distance

The reader with an imagination is asked to recall the fact that the astronomer at Washington is at one point upon a ball which revolves once in twenty four hours The ball itself travels about the sun once in a year through a path which is some six hundred million miles in length The sun and all its train of satellites, of which the earth is one, is moving through space toward an unknown destination Yet in spite of these complicated movements, at tremendous speeds, the astronomer reaches a star with an arm of light determined an instant of time for a single place and calls it noon, and then with an arm of unseen radio wave in an unknown medium he calls the ether, sends that instant broadcast to all the world, for all the world to pick up and use and depend upon for everything it does, from going to breakfast to going to war, or deciding the boundary between states or the exact and accurate location of those who go down to the sea in ships.

Using Cadmium to Galvanize Iron

WHILE it has long been known that so-called galvanized iron could be made with cadmium in place of zinc, its high price prevented such use A writer named Grès states in the *Bulletin des Inventions* that this difficulty has been overcome since it has been found possible to galvanize 1 square meter of sheet iron with the use of only 34 grams of cadmium The coating thus produced is more resistant than zinc to acids, salt water and damp air In spite of its thinness it clings to the iron with great tenacity, not [illegible] even when the latter is bent.

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IN THIS ISSUE:

A NEW PROFESSION
A PROBLEM IN LEVELS

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

CROSSING THE GRANITE GORGE BRIDGE WHICH SPANS THE COLORADO RIVER.- [See page 203]

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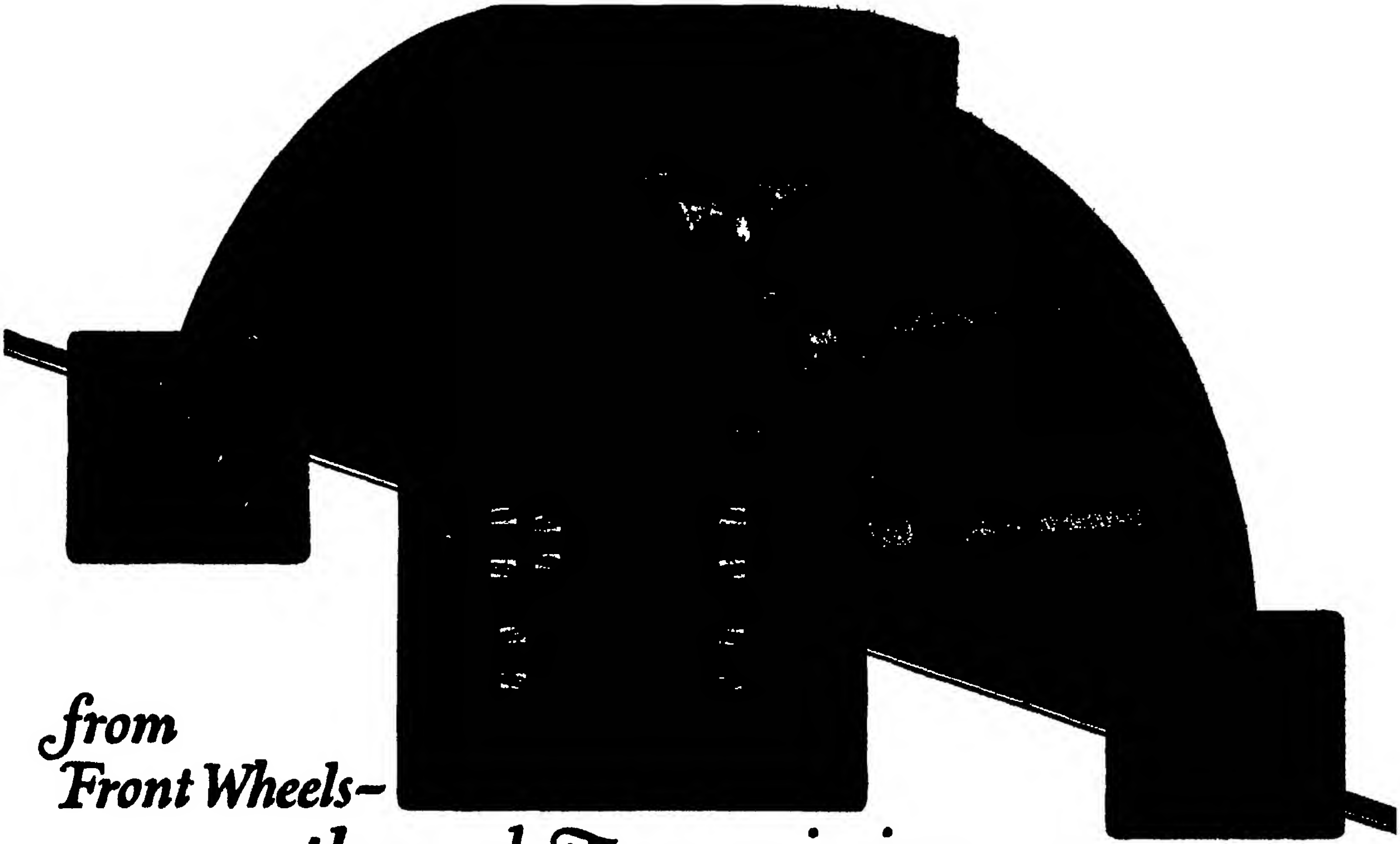

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SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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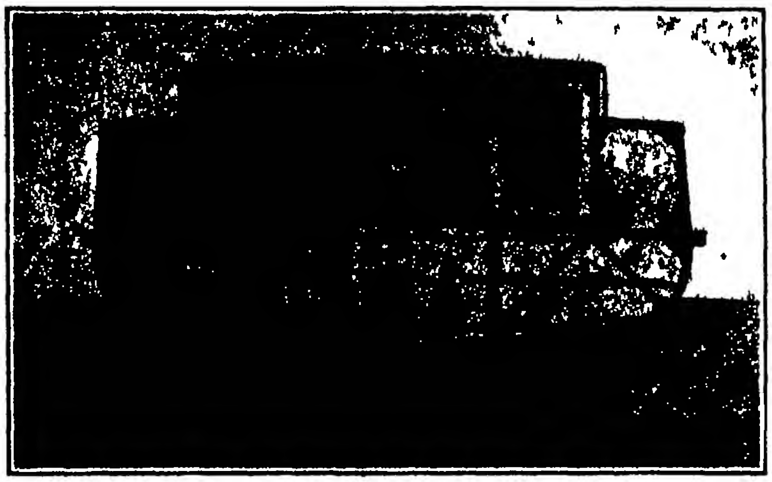
A New Type of Ferryboat

THE noteworthy expansion in the use of automobiles for touring purposes and of motor trucks for freight transportation has resulted in the development of a problem for ferry companies that has been difficult of solution by reason of the limited automobile carrying capacities of the prevailing types of vessels used for ferry purposes. To a certain degree this is the underlying basis for the high charges made by ferry concerns on automobiles and motor trucks seeking transportation across short bodies of water.

The Hulifin type of ferryboat, as here illustrated, affords over 100 per cent greater automobile accommodations than the usual ferryboat with a considerable increase in hull length. A survey of the largest marine steam ferryboat now building measuring 225 feet long and 60-foot beam over guards shows 410 feet of drive ways, whereas the Hulifin ferry which is to be built for the Poughkeepsie and Highland Ferry Company will be only 140 feet long and 52 foot beam over guards and will have a total length of 472 feet of drive ways. Its capacity notwithstanding the smaller length of the boat, comes from its having four driveways whereas the usual ferryboat has only two driveways. This is due to the fact that the propulsive equipment does not occupy any space on the main deck being located as shown in the accompanying plans in the hull and fin.

The new ferryboat will have all of its machinery below the main deck. The deck beams are unbroken throughout. The shoal broad hull with full ends refined by the Arconstruct method, giving unusual ice crushing qualities, a method of construction that can be had only through the use of the Hulifin system without a corresponding greater increase in hull surface resistance will afford greater stability and buoyancy with no noticeable increase in draught when the vessel is heavily loaded. Vehicle transportation on present ferries necessitates even distribution of the load owing to the hull type whereas on this type of ferry vehicles can be placed indiscriminately without dangerous careening or tilting.



Sectional view of the Hulifin type of ferryboat, showing the increased space for vehicular loads

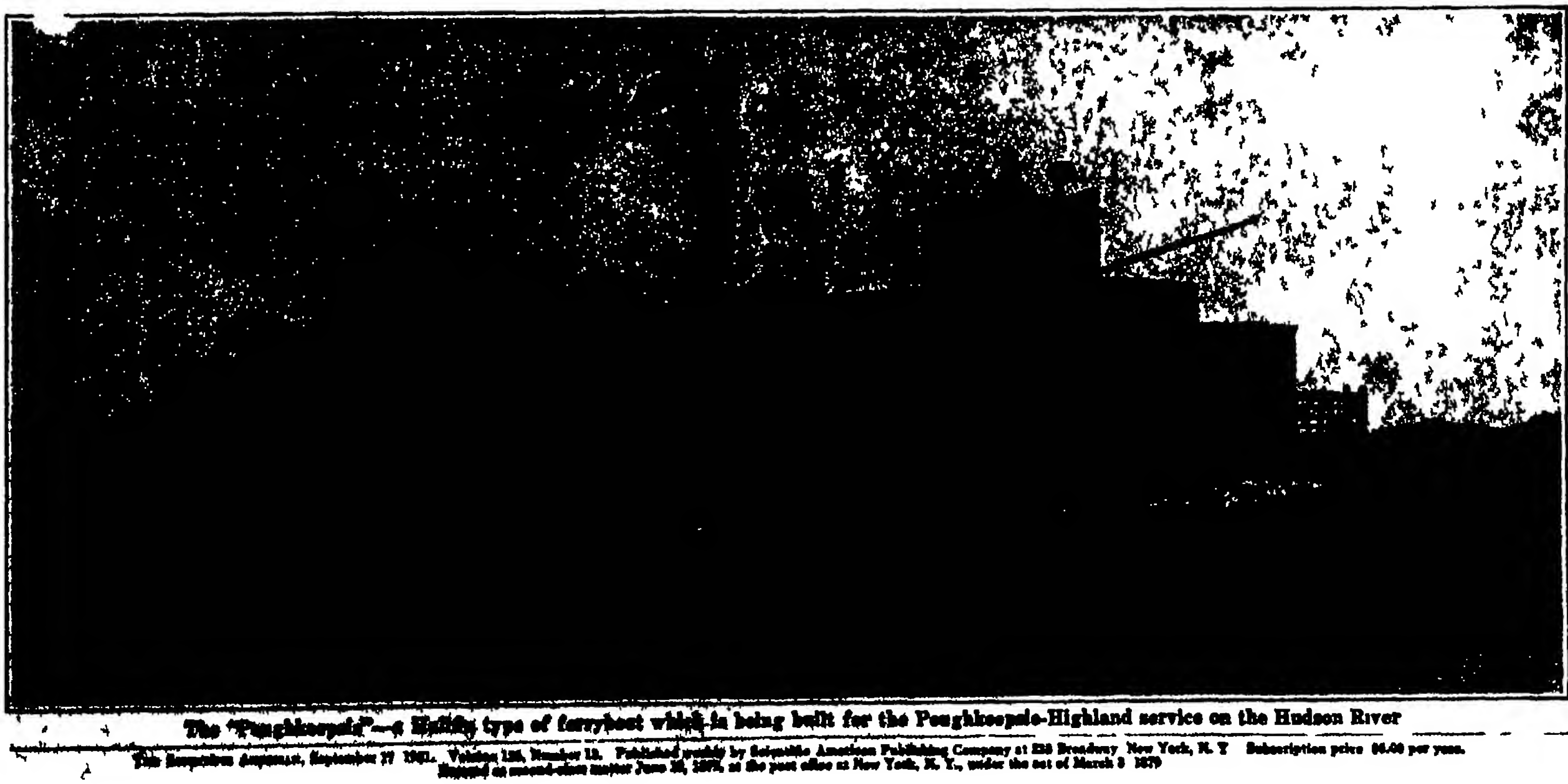
The electric motors are mounted directly on the propeller shafts, and cavitation being precluded small propeller wheels are used effecting maximum propulsive force per shaft horsepower.

Water projected from the propellers cannot escape to the surface owing to the hull above hence the confined water column makes possible greater thrust necessitating less power expenditure for a given speed and displacement than in ordinary practise. Another advantage claimed for this type is that it eliminates abrupt stern posts and rudders and the confined space at the propellers obviating vibration and attending depreciation of machinery which though usually attributed to engines is actually due to the aforementioned causes.

The new ferryboat will be equipped with two six-cylinder Winton full Diesel engines each direct connected to Westinghouse generators. There will also be a six-cylinder Winton generator set for lights, pumps, etc., and a Winton air compressor and exciters chain driven from main engines. The pilot house will have electric control and there will be arcola heaters, electric pumps, Westinghouse electric driving motors and complete subsidiary elements conforming to the most advanced engineering practises.

Rings Bell if Water is Found in Gas

A DEVICE which gives an alarm if the presence of a minute trace of water vapor is detected in a gas has been recently developed by the Gas Chemistry Section of the National Bureau of Standards. The apparatus depends upon the electrical conductivity of a film made of a substance highly sensitive in revealing the moisture in the atmosphere. For example phosphoric acid was employed which as long as it is wet has a high conductivity but as it dries it is deprived of its conductivity. The new water indicator operates under the principle of keeping this at a constant temperature and the device is made part of a circuit to ring a bell or operate some other signal.



The "Poughkeepsie"—a Hulifin type of ferryboat which is being built for the Poughkeepsie-Highland service on the Hudson River

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Those Martian Radio Signals

DESPITE its unique nature and its wealth of wonders, the radio art has its cycles, the same as many of the more commonplace fields of endeavor Every so often we enter into a cycle of perfected radio, when we are told and assured that radio communication has been perfected and little remains to be achieved Static interference from undesirable transmitters, and the several detrimental influences, such as sunlight, have been overcome, so we are informed Then but a short while later we learn that much remains to be done in the radio art, and that someone has been rather premature in his assertions.

And then there is the cycle of intense radio development, when radio telegraphs and radio telephones are to dot the world with thousands upon thousands of stations to the discomfiture, if not the doom, of telegraph, telephone, and cable Still, the more conventional methods of communication seem to prevail, and the intensive radio development fails to materialize

Again, there is the Martian radio signal cycle, which comes around every few years, more or less, with surprising regularity The newspapers 'play up' the announcement that mysterious signals have been intercepted, and give it all the significance and comment that goes with an opening page story The radio fraternity immediately splits into three camps—the believers in Martian signals, the out-and-out and irreconcilable non believers, and the neutrals.

Just now we are in the Martian signal cycle again, after a lapse of something over two years The facts in the case are that Mr J H C Macbeth, London manager of the Marconi Wireless Telegraph Company Ltd, recently stated in his speech at a Rotary Club luncheon in New York, that William Marconi was now convinced that he had intercepted signals emanating from a source outside this earth The signals which have been intercepted are reported to have an extremely long wave length, indeed, this fact alone now precludes the suggestion that they might originate in some experimental station in a remote corner of the world

To be specific Mr Macbeth informs us that the maximum length of waves produced by radio stations in this world today is 17,000 meters Until Marconi conducted his experiments on his yacht the "Electra," in the Mediterranean several months ago, radio receiving apparatus was capable of receiving wave lengths up to 24,000 meters. His receiving apparatus was tuned to many times this figure, and it is estimated that the waves which he intercepted were of the order of 150,000 meters Furthermore, their regularity disproved any belief that they were caused by atmospherics.

So much for the bare facts. Two or three years ago, when Martian signals were the topic of heated controversy in radio circles, we offered by way of possible explanation the fact that Soviet Russia was said to be hard at work on several long range radio stations for the purpose of establishing communication with the world at large Now that many newspaper correspondents, Red Cross workers, Government representatives and others have penetrated into the farthest corners of that famine-stricken country, we know only too well that the unfortunate Russians have plenty to do besides seeking new means of radio communication Still, it is not altogether impossible that the signals emanate from some radio transmitter on this earth, either intentionally or otherwise In radio transmission there is a phenomenon known as harmonics, in which a transmitter tuned for some definite wave emits supplementary waves of an altogether different wave length Again, the extreme sensitiveness of the apparatus employed in present-day radio causes one to pick up the hums and the clicks of various commonplace circuits such as an ordinary electric elevator, electric street car, lighting circuit, bell circuit, telephone, and so on In fact, the signals one picks up do not necessarily have to be radio signals.

But let us not assume for a moment that a man of the experience and knowledge of Marconi would confound such commonplace parasitic disturbances for radio signals. What Signor Marconi has heard must be signals that are distinctly out of the ordinary

Somehow or other it is difficult to subscribe to the belief that radio signals are being received from Mars. Radio communication is such an intricate and exceptional development that it would be very rare indeed if two peoples, located on different planets, should have worked out precisely the same method of communication We can more readily believe in the Martians making use of huge mirrors for reflecting light, or even huge searchlights, as a means of attracting our attention It would seem that the cause of the mysterious signals must be sought nearer home. The harmonics of transmitters, atmospheric disturbances, magnetic storms and phenomena, sunspots and their peculiar influences—these possible causes are surely worth studying, not only for a solution of our present mystery but for the good of radio communication

The Other Side of the Picture

THE United States has some 240,000 miles of railroads, and 2,500,000 miles of common road Plainly enough the two systems must intersect in countless places, and comparatively few of these intersections can be other than at grade With upward of 10,000,000 individual automobiles in operation, and with an annual train mileage little if any less than 10,000,000, nobody expects that grade-crossing accidents are going to be reduced to an absolute zero.

The onus of a crossing smash up is ordinarily put upon the automobilist, and rightly so He can stop in a fraction of the time and distance required by the train, and he can turn from his course He is the party who is going to get damaged by any collision that may occur He is therefore the party to whom we may reasonably look for precautions, and in many specific cases smashed gates and other evidence make it clear that he failed to take them

At the same time there are two sides to this as to every story, the automobile has certain rights even in the presence of a fast mail train A number of our railroads recently collaborated in making and publishing a survey of the behavior of automobile drivers on approaching crossings. A deplorable proportion took no precautions to speak of But the climax of the report was built out of the fact that only three drivers in a thousand "came to a full stop and looked both ways" before crossing It was not explicitly stated that they all ought to have done this, but the inference was plainly left for the reader to make

Now this is certainly unreasonable That we ought to drive up to a grade crossing at a moderate pace is admitted—more definitely, that we ought to approach at a pace permitting us to stop before we get upon the tracks, if it becomes necessary to do so But we will freely confess that we never yet have come to a full stop at a grade crossing out of mere suspicion, and that we never expect to.

At the same time we have seen grade crossings where we have been strongly impelled to make such a stop, in recognition that we could not tell, until we were squarely on the tracks, whether a train was coming or not Some of the blind crossings are doubly so—not alone are approaching trains hidden, but the very presence of the crossing is apparent only at the last moment. All over the country we meet crossings of the jog type, where a road runs for miles parallel to the track, without warning to turn across at right angles. We know at least three such where the outside of the turn is at the top of a steep bank, so that the only alternative to hitting a train might be taking the plunge. For the reckless driver we hold no brief, nor do we deny his existence in vast number; but we do insist that no road ought to present trick crossings of such character that the conservative driver must be familiar with the road in order to be safe.

Of course the dangerous crossing is usually marked. But too little effort is made to discriminate between the crossings that are really dangerous and those that are not. In many states death's-heads and huge placards "MAN KILLED HERE" are posted at every crossing that has seen a fatality We have seen such signs at crossings that were as wide open as it was possible for them to be—at the bottom of a hill, with a mile or more of the track in plain view of motorists approaching in either direction. The only effect of such indiscriminate placing of signs is to weaken the motorist's attention to them

Cathedral Catastrophes in the Middle Ages

AS we sit at our desk with over 600 feet of the Woolworth Building held in mid-air above us, our thoughts run back to the cathedral builders of Mediaeval days and the not infrequent catastrophes which befell those soaring structures of fretted stone and painted glass which are today the delight and admiration of every artistic soul To raise a Woolworth Tower some 800 feet into the air, and do it with such materials and in such fashion that it will stay there forever, is a simple task compared with that which confronted the Mediaeval architect when he dared to erect on four tall and relatively slender piers the towers and spires of a cathedral such as that of Salisbury, with its total height of over 400 feet, or even a square tower such as the famous and beautiful angel tower at Canterbury, which reached only a modest 230 feet above the ground level For the builders of those days knew but little about the abstract theory of stresses, and they had no such formulæ as are at the call of any college student today

The bishop of those days was more often than not the architect of his own cathedral; and there is much evidence in the cathedrals as they stand today that his work, at least in the earlier stages of the development of the Gothic art, was experimental He built a massive, vaulted roof upon relatively slender piers and made a guess at the necessary diameter of piers, thickness of walls and so forth to hold his vault in place If there were just enough material used and it were of fairly good quality, the work stood If there were two or three times as much material as was necessary (and this, we have evidence, not infrequently happened) the work stood and all was well, but if their piers were too small in diameter, their walls too thin, or the rubble work constituting the core of the masonry was too poor in quality, down came the whole structure and the good bishop set about rebuilding, profiting by the costly lesson he had learned

A most frequent cause of trouble was the great tower which was so much favored at the intersection of nave and transept. If there was to be an uninterrupted view throughout the full length of nave and choir, or from transept wall to transept wall, it became necessary to place great arches as tall as the roofs of the cathedral themselves at the intersection of nave and transept. Now this meant, of course, the cutting of huge gaps in the walls of the tower, concentrating the weight of the upper stages of the tower, which would run up to 4000 or 5000 tons, upon the four piers. That was a serious problem in itself, but worse than that, the effect of the huge tower load upon these arches was to produce a heavy lateral thrust, which had to be absorbed by the adjoining walls of nave and transept.

And what trouble they had! Piers would begin to buckle and would be hastily reinforced by adding to their thickness, arches would spread, causing great rents at the crown or thrusting the adjoining pier arcades out of the vertical To remedy this and prevent disaster, the builders, as at Gloucester Cathedral would carry buttresses right down the side walls, cutting diagonally across the aisle and transept windows until they could transfer the load to some outlying buttress or suitable mass of masonry To the engineer and architect, by no means the least attraction of the wonderful cathedrals of France and England are the failures with which they were threatened and the clever expedients by which the emergencies were met.

Steel for construction was unknown in those days and iron was very, very scarce Had they possessed these materials and our twentieth century knowledge of engineering, what stupendous buildings those priestly architects would have produced, particularly in northern France, where at Amiens, the crown of the vault is over 140 feet above the floor of the cathedral and at Beauvais, where in the effort to outdo Saint Peter's, Rome, the French carried their roof to an interior height of 156 feet—and all of this, mark you, in stone

Automobile

New York's Stolen Car Industry.—It is reported that there were 7005 automobiles valued at approximately $7,000,000 stolen in the cities of New York State during 1920, according to figures compiled by the information bureau of the State Conference of Mayors. Of this number 3996 machines were recovered by the police.

A Danish Motor Vehicle Census was held on Sept. 1, 1920, and showed that on that date there were in the country 11,594 private passenger cars, 2276 motor cabs and omnibuses, 3787 motor trucks and 12,182 motorcycles. The rapid increase in the number of cars and trucks in Denmark during the past three years is noteworthy The increase was specially great in the country districts.

Loose Nuts and Trouble.—The vibration on an automobile is so severe that nuts will loosen occasionally in spite of all precautions. A loose nut may cause the breakage of an important part or may even be the cause of the wrecking of the car It is a worth while safety measure to go over the nuts on the car about once a month Ordinarily the work will not take more than five minutes' time

Solders for Aluminum.—All tests on recent aluminum solders have been completed by the Bureau of Standards and Circular 78, "Solders for Aluminum" will now be revised to include these tests. In spite of claims made by those interested no solder for aluminum has yet been found which will withstand the corrosion test, although the fused zinc chloride solders resist it for the greatest length of time

The Rocker Arms on overhead valve engines should be oiled religiously, unless provision is made for oiling them automatically from the engine, which is rarely the case Usually the oil-can method is employed for lubricating these parts, and it is good practice to oil them every morning before taking the car out of the garage It is work that only takes a moment and it prevents undue wear, which in turn insures a quiet and well running engine.

An Oil Gun designed for use in a chassis lubricating system consists of a nickel plated metal bottle in which are located a piston and a heavy coil spring The oil is contained in the upper part of the bottle and is put under pressure by the piston and coil spring A length of flexible tubing is attached to the top of the bottle and the end of the tubing is equipped with a check valve which is released by the special fittings which replace the grease cups and oil cups on the car

Gasoline Mixed With Alcohol or with benzol is now exempt from the French State tax of 20 centimes per liter The decree declares that the mixture can be either 50 per cent alcohol and 50 per cent gasoline or a mixture in equal proportions of gasoline, alcohol and benzol Benzol and alcohol are readily mixed. Alcohol benzol mixtures will not freeze at low atmospheric temperatures, but unmixed commercial benzol freezes at about 23 degrees Fahrenheit. The lightest grades of gasoline mixes with alcohol, but with heavier grades, and with kerosene separation occurs. Separation is prevented by addition of a mutually blending solvent such as benzol

The Heat of the Engine which generally comes through the slots in the footboard of the average automobile is something which might well be remedied In fact, it seems that a double wall, with a live air space between, could be placed between the engine and the front seat of the usual automobile, thus providing some protection against the excessive heat during summer driving Furthermore, the usual pedal controls could be provided with some form of shields which would serve to stop the openings in the slots yet not interfere with the operation of the pedals. This phase of the automobile has undoubtedly been left in its original state, yet it offers a good field for the efforts of the ingenious mechanic

The Friction Drive is again receiving attention after a long period of more or less total abandonment. At least one new make of car has lately made its appearance on the American market, in which an improved form of friction drive is employed with what are claimed to be important advantages over the usual gear drive. It will be interesting to note how this car thrives in everyday use. One thing is certain, the friction drive is excellent for small, light cars. One car making use of that form of drive made an enviable record for itself while it was being manufactured Cars of that same make are still in existence, and their performance and low upkeep costs are truly remarkable. However, with the demand for larger and heavier cars the car in question gave way to other makes which had more to offer in the way of appearance and comfort at the same or less cost.

Science

Pike's Peak Aerial Patrol.—A Colorado aircraft company has agreed to keep a sharp lookout, without expense to the Forest Service, for fires in this district, which is remote from any army air field.

A Large Candle.—Here in New York is being made the king of all candles It will be five feet in circumference and eighteen feet in height, and will weigh more than 1000 pounds. It is being paid for by the orphans of a home to which Caruso contributed $10,000 a year, and is destined for a church in Naples The maker estimates that it will burn for 120,000 hours.

Progress of the Metric System.—Metric weights, now obligatory on Chinese railways are said to have given rise to no trouble or complaint. The metric system went into force in Malta on July 1st. A chart issued by the Decimal Association shows consistent gains for the system during the past hundred years, with a particularly sharp rise to popularity in the last ten years.

Protein Tests.—Boston hospitals have been conducting experiments in protein sensitization by inoculating patients with proteins from foods and other substances. The reactions or absence of reactions are studied with particular regard to asthma and hay fever, but are being extended to indigestion children's ailments and other diseases The protein is applied in a weak solution of sodium hydrate to a tiny scratch on the skin.

Spitzbergen's Resources.—Spitzbergen, that long-ignored archipelago of the frozen north, is revealing its value Its coal resources are estimated at 9,000,000,000 tons, it has much low grade iron ore, deposits of copper, zinc, molybdenum, asbestos, gypsum and oil shale, and possibilities of free oil Good harbors, frequent communication with Norway, and a climate comparable with that of Sweden, augur a prosperous future for the islands.

Chemical Industries Exposition.—The Seventh National Exposition was held in New York the week of September 12 The spacious drill floor of the Eighth Coast Artillery Armory accommodated 400 exhibits. In its auditorium were held symposiums and motion picture demonstrations. Chemical engineers from all States and abroad were here for the joint meeting of the Society of Chemical Industry and the American Chemical Society

Osmiridium in Tasmania.—Recent exploration and development have revealed enormous deposits of osmiridium and gold bearing gravels in the valleys of the large rivers of the western division of Tasmania, which is the sole producer on a large scale of "point metal" osmiridium Tasmania, Russia, Colombia and Papua are the four principal osmiridium producing countries of the world, and Tasmania is by far the most important of these

Science and Shoes.—Speeding up tanning without sacrificing leather quality is a question to be thoroughly discussed at the coming meeting of the American Chemical Society at Columbia University Quicker tanning means time saved more frequent turnover of capital, and leather—and shoes, which is what most men think of when leather is mentioned—at lower prices. Noted European leather chemists will attend this meeting, where novel tanning methods based on the study of electrical discharges will be described

The Magellanic Gold Medal.—This medal will be awarded in December to the author of the best unpublished discovery, invention or improvement relating to astronomy, navigation, or natural philosophy (mere natural history alone excepted) The contest is open to all, but the discovery must be delivered free of charge to the President of the American Philosophical Society, 104 South Fifth Street, Philadelphia, on or before November 1st. It may be in English, French, German or Latin, and must be distinguished by a device or nom-de-plume and accompanied by a sealed envelope bearing the same device and containing the true name and address.

A Good Short Story.—The following is a museum label and is one of the best short stories ever written For brevity and for conveying accurate information, it is worthy of perpetuation "Far back in the past, during that period in the worlds' history known as the Triassic, the State of Connecticut was largely covered by the sea, and a bay, or estuary, extended as far north as Turner's Falls, Mass. One day, when the tide was out, one of the great reptiles, known as Dinosaurs, walked along the beach, leaving his footprints in the sand. The tide came in, the tracks filled with sand and mud, in the ages that followed this became stone, and a few million years later, in quarrying stone for New York houses, this track was uncovered."

Astronomy

Astronomical Postcards.—A second edition of Prof Max Wolf's astronomical picture postcards has been published by the Pallas-Verlag, in Jena The set comprises ten cards in an envelope, and sells for 7 marks.

Photographs of Mars.—It is stated that upwards of 100,000 photographs of Mars have been taken at the Lowell Observatory, Flagstaff, Ariz. Numerous exposures are made on each plate in the hope that some will catch the moments of best definition.

The Astronomische Gesellschaft, after having held no meetings for eight years, assembled in Potsdam in August of the present year The former president of the society, Geheimrat von Seeliger, has resigned, on account of poor health, and has been succeeded by Professor Strömgren, of Copenhagen

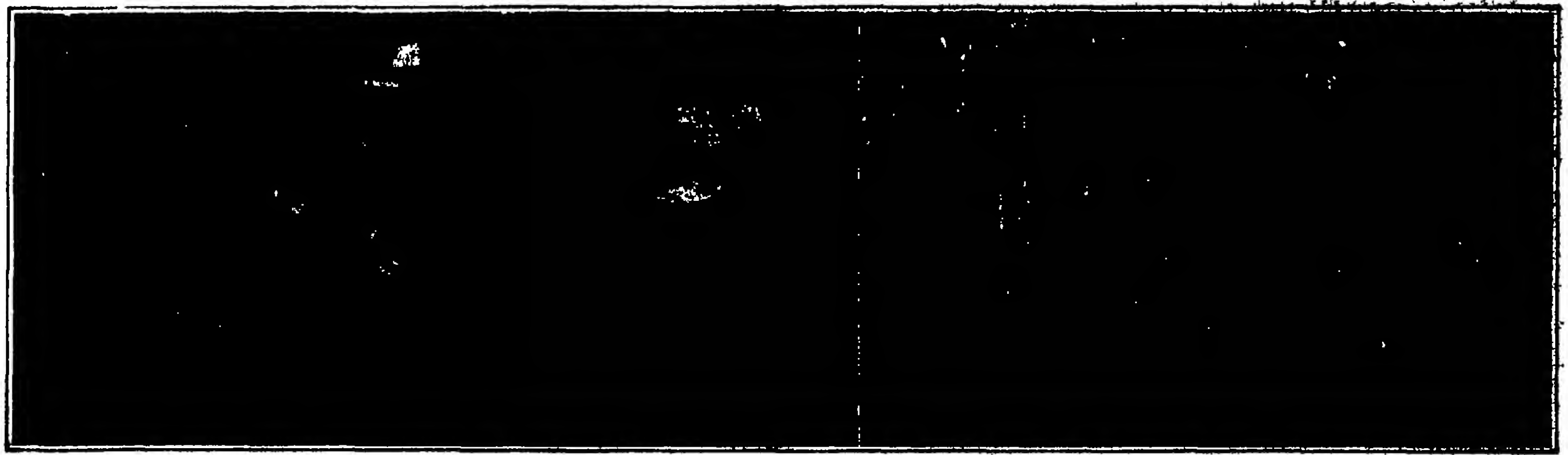
Nova Aquilae No. 3.—Dr R. G Aitken reports that this object was examined with the 36-inch telescope of the Lick Observatory on three nights in June and July On June 4 it was noted that the blue-green nebulous envelope or halo which was so conspicuous in 1920 had become very much fainter and apparently larger, but the seeing on this occasion and on June 8 was not good enough to permit accurate measures. On July 7 seeing was excellent, and the nebulous envelope, though faint, was well defined The diameters, north-south and east-west, were measured and found to be 5.07 and 4.98 seconds, respectively The disk appeared to be perfectly round and the star to be placed centrally within it.

The Size of a Dark Nebula in Taurus is discussed by Dr A. Pannekoek in the *Proceedings* of the Amsterdam Academy of Science From data of star-density in this region, he estimates the dark nebulous matter to be 140 parsecs distant from our system, or four times the estimated distance of the Hyades. On this basis the length of the nebula is 70 parsecs Its mass, assuming it to consist of hydrogen, is estimated at twenty thousand million times that of the sun This, as Dr A. C D Crommelin points out is greater than many estimates of the combined mass of the whole sidereal system, and suggests the probability that the larger portion of that mass is not condensed into stars but distributed in cosmic clouds

A New Hypothesis of the Aurora.—Most recent students of the aurora, such as Störmer, Birkeland, etc, ascribe the phenomenon to the entrance into the atmosphere of charged particles from the sun Dr L. A. Bauer, in a current paper, quotes a suggestion that he has received from Prof A E Kennelly to the effect that the electrified particles entering our atmosphere from without over the parts of the globe on which the sun is shining would set up a compensating outward flow of electricity over other portions, and that it is the latter rather than the former that causes the visible aurora. Dr Bauer's opinion is that "probably both possibilities—an entering charge and an emerging charge—will have to be taken into consideration"

A Novel Type of Observatory.—The 18-inch reflecting telescope recently presented by Mr G R Hoskins to the people of Sydney, Australia, is housed in a building which differs considerably from the ordinary type of observatory The floor surrounding the concrete block upon which the telescope is fixed is the only stable part of the building, the sides and roof of which revolve One enters the building through the door which may at the time be facing south, but when one leaves it may be on the opposite side The shutter in the roof is also a novelty not folding or sliding sideways, as usual, but running upward in a frame The observatory is under the supervision of the New South Wales Branch of the British Astronomical Association

Effects of the Earth on the Sun.—That many terrestrial phenomena are more or less directly controlled by the sun is a matter of common knowledge, but the idea that our small planet exercises appreciable effects upon the sun is comparatively novel According to Dr L. A. Bauer, a discussion of the sunspot numbers for the period of 44 years, 1877 1920, indicates the existence of an annual periodicity in sunspottedness, consisting mainly of a single wave the minimum occurring about the time (January) when the earth is nearest to the sun, and the maximum occurring on the average in July, when the earth is farthest away from the sun The average difference between maximum and minimum is about 6 sunspot numbers "There is thus," says Dr Bauer, "given, seemingly, support to the results of others with regard to a possible earth-effect on various solar phenomena.' Evershed, from spectroscopic observations on Venus, has inferred that the earth exerts a repulsive effect on the solar gases analogous to that which the sun appears to exert on comets' tails.



Left: The register at Wenatchee Forest, Wash., which enables the camper to be reached from the outside world. *Right:* Campers in the White Mountain National Forest, N. H.

In the National Forests where the recreation engineer has been at work

A New Profession

The Recreation Engineer and His Part in Making Our Vacations Worth While

By Avis Gordon Vestal

THAT "all work and no play" may not "make Jack a dull boy," there has recently opened up a new profession recreation engineering, called by others landscape engineering, recreation landscape design, or forest recreation Scattered examples of such work have been done in past years, as a side issue, by persons whose main business was forestry or engineering or administration of public lands, but the recognition of play preparation as a distinct profession, requiring technical instruction, is new As yet, colleges offering such courses are few, their graduates not numerous. Those actively engaged in its teaching or practice are enthusiastic pioneers who believe that the time is ripe for a great expansion of informal out-door living and recreation for city-weary folk, adults and children, who are flocking to the big open spaces in family groups or as large organizations.

Camp-fire place at Silver Creek in the Michigan forests

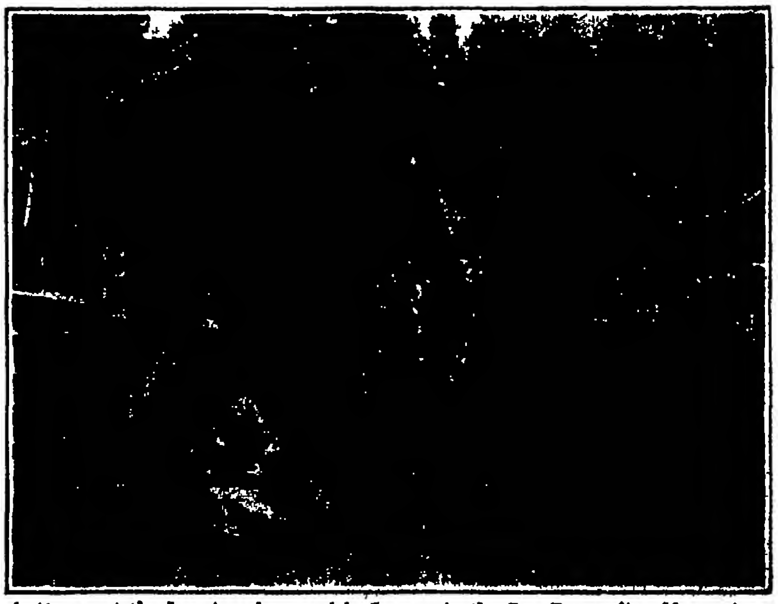
What the profession does not include may help to its understanding. It isn't playground management, which supervises people while engaged in play *nor yet the familiar and formal planning of* city parks. It is distinct also from the work of landscape gardeners and architects when they are preparing private estates for the enjoyment of a selected few It is not even engineering, as its exponents admit, though it overlaps it in preparation and practice

Iowa State College of Agriculture and Mechanic Arts, at Ames, has for two years offered a splendid forward looking course Frank H Cully, the professor in charge, offers the following definition of the work

"Recreation landscape design is a specialized adaptation of professional landscape architecture It applies all the fundamentals of this art to areas which are being used for specialized recreation As a rule, the landscape architect who is interested in recreation landscape design is designing on a much larger scale and for a larger group of people than the one who is doing city planning or estate work. No recreation landscape designer could be a success without being a thoroughly and technically trained landscape architect With this in mind we have built up at this institution a course which will allow our students to specialize in this particular phase of the professional practice. The student is required to take our landscape architecture course and in his senior year he specializes in recreation landscape design. We are offering two sources in this subject, supported by elective subjects in the Forestry Department, such as 'Municipal Forests,' 'Forest Administration and Protection,' and 'Forest Management.' The student also gets considerable surveying, roads, pavements and geology"

The *recreation engineer for the Second District of* the National Forests, Arthur Carhart, contributes to the definition 'Recreation engineering is a field of land scape architecture and is primarily a fine art rather than a science. It is the preservation and production *of beauty in the landscape and the adaptation of land* surfaces to human use. It takes what is needed from the fields of engineering, geology, chemistry, horticulture, psychology and sociology It deals with broad, public natural areas, such as national and state parks and forests, county forest preserves, such as those of Cook County, Illinois, or municipal forests. The problems are different from those in city parks. Details fitting admirably a Lincoln Park would be as out of place in the Superior National Forest as a striped jersey at a ministerial reception!"

The New York State College of Forestry, at Syracuse University, has for two or three years offered instruction in the new profession under the name of "Forest Recreation" Prof. Henry P Francis stresses forestry as the background of the course, rather than the art of landscape architecture, yet the object he seeks to serve appears to be the same as that for which Professor Cully trains his students. Professor Francis has for some years himself carried on landscape extension work in Massachusetts and New York. With one of his graduates he is spending this summer vacation doing field work in the new Allegheny State Park in southwest New York, planning its recreational development. It adjoins land in Pennsylvania, which, should it be similarly developed, would make a most attractive interstate park



Cottages at the Los Angeles municipal camp in the San Bernardino Mountains, 75 miles from the city

"Forest Recreation," Professor Francis states, "embraces the many and diverse uses of forest areas for the enjoyment of leisure by all the people. In its broadest meaning it includes all manner of provision for and ways of using leisure in connection with the National Parks, National Forests, State and Interstate Parks, County and Municipal Preserves, and all other public forest areas. The work will depend upon foresters with proper training in recreation uses of forest areas to bring about the greatest public good." Professor Francis offers to undergraduates four courses of 3 hours per week throughout a year, "Elements of Forest Recreation," "Principles of Forest Recreation," "Recreational Problems," and "National Recreation Policies in Forests and Parks." A 4-hour research study is arranged for graduate students.

The Massachusetts Agricultural College, at Amherst, is credited by Professor Cully as having first interested the United States Forest Service in this phase of the use of the National Forests. Prof. Frank A. Waugh, to whom the personal responsibility for this attaches, writes: "We do not give any courses in forest recreation as such, but the problems in

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Philadelphia's Tear Bombs and Mobs

By William A. McGarry

A DEMONSTRATION that might have been billed as the re-enactment of a brisk raid through no man's land on the western front was held recently under police supervision on the meadows of South Philadelphia, serving to introduce the bluecoats of the Quaker City to a new offensive weapon against bandits and mobs—a weapon developed out of the poison gas warfare that was so bitterly denounced when it was first introduced By actual tests against fifty stalwart members of the police "rookie squad" who courageously volunteered for the test, it was shown that tear gas bombs of a type recently invented are quite as effective as rifle or revolver fire, and far less deadly

Two types of these bombs are now or shortly will be on the market for use not only by the police, but also by banks, storekeepers and paymasters. One contains the familiar lachrymose gas, the other what is known as "stunic" gas. As its name indicates, the latter stuns one who inhales it, leaving him virtually unconscious and utterly helpless for some minutes. The chemical constituents of the mixtures used in the bombs for the Philadelphia demonstration are withheld by the inventor Experts of the chemical warfare section, however, are authority for the statement that this service has worked out several formulas for both types of bombs, all of which may be used without permanent injury

This feature of the new gases and particularly of the lachrymose gas led Superintendent William B Mills of the Philadelphia police to determine, after the demonstration, to establish five gas bomb squads. It is what makes highly probable the adoption of the bombs by banking institutions. Few persons care about the bandit or the bank burglar and it is a matter of little concern whether or not he is permanently injured But gas clouds are no respecters of persons and under many conditions where their use might be advisable to stop crime innocent bystanders also would be caught.

According to a physician who handled thousands of cases of all kinds of gas poisoning on the Western front in France and who is now in charge of convalescents at the United States Public Health Service Hospital in Philadelphia, the effect of the tear bombs shown to the police in that city is identical with that caused by the lachrymose gas used by the Germans during the last few months of the war, although the chemical formula may be different. The gas causes irritation of the conjunctiva, the mucous membrane of the lining of the eyelids and of the anterior part of the eye itself. This disturbance is so intense and painful that it is impossible for the victim to keep his eyes open, and he is rendered helpless for from five to twenty minutes, depending on the concentration of the vapor when it makes contact with his eyes In no case is there any permanent ill effect.

Knowing that the results would be exceedingly painful, the rookie squad nevertheless volunteered to be the victims of the demonstration. It was given on the "model farm" which Philadelphia operates on the meadows near the League Island Navy Yard. Major Stephen J De Lanoy, formerly connected with the Chemical Warfare Service, was in charge He and his aides first taught a group of "bomb throwers" the proper method of hurling the missiles to the best advantage Then the rookies formed themselves into a "mob" about one hundred yards away from the police, and charged They were permitted to cover about half the distance before the bomb throwing started

Four bombs then were hurled in the path of the charging men The seven inch rubber containers bounced once or twice and then exploded one after another, with sharp reports. Dense clouds of white vapor rose, spreading slowly in all directions to almost unbelievable volume This soft white vapor, shifting before the light breeze, might have been a stone wall. It brought the "mob" to a dead stop within fifteen feet.

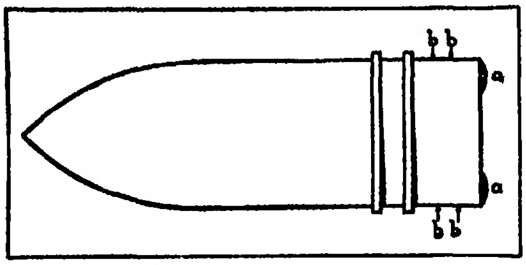
The mechanism of the bombs is extremely simple, and this is the feature that is expected to make them popular with the police and with paymasters who must travel lonely roads. They are exploded by a spring detonator that is generally set for five seconds, although this may be regulated to suit. This mechanism fits into a tube which is inserted into the top of the seven-inch rubber container after the latter has been filled with the charge of chemical compound. The spring is released by pulling a ring in the neck of the tube, so that, it is claimed, the bomb cannot go off until this ring is pulled, even though it is accidentally dropped.

When the bomb is to be thrown the ring is pulled with one's finger. But it is claimed that with a little practice a bank teller, for instance, could learn to make use of the bombs with either hand and set the spring with a slight pull of his thumb He will then have five seconds to don a mask, or to jump for cover, unless in order to be doubly sure he has set the detonating mechanism to function at one second A demonstration of the stunic gas within a building was given at the same time as the tear gas exhibition, four bluecoats offering themselves up for sacrifice They were unconscious from five to ten minutes each, as only sufficient chemical was used to show its effectiveness

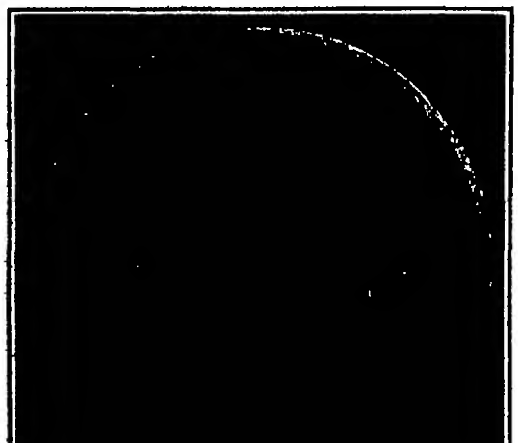
The police are particularly hopeful that the bombs will be of value in chasing motor bandits In every large American city this type of highwayman has been able to elude arrest again and again even when police

(Continued on page 209)

The police tear-bomb, showing its size in relation to the human hand



Two modes of applying the tin-lead alloy



75-millimeter shell, "metallized" by the Dagory process, and recovered after firing. The action of the metal is clearly indicated

Copper-Fouling of Ordnance Materials

By A. Dagory

THE importance of the phenomenon known of artillerymen under the name of "copper fouling" or "encopperlng" was not revealed before the war It was only after the heavy firing that took place on the French battle front from 1915 that it proved to be so important and that its serious consequences were fully realized

We give a brief statement on this phenomenon and a description of the remedy that was adopted after long and fruitless attempts suggested by several inventors. The simple process by which the difficulty was overcome was presented in 1916 by the author of this article

After a number of shells have been fired, said number being variable according to type of gun, a certain amount of copper scraped off the copper driving bands of the projectiles adheres both to the grooves and walls of the gun tube Such deposits firmly stick to the bore and if the gun goes on firing, their thickness soon becomes so great that they affect the behavior of the shells and this to such an extent that their influence is most injurious The effects of said injury can be summed up as follows

(a) Part or total impairment of the rifling giving rise to considerable irregularities in firing ranges.

This defect is so great that with copper-fouled 32 mm guns there is a serious shortening of the range Sometimes, even, the shell "tumbles" along its trajectory

(b) Bursting of the shell in the gun bore, due to a premature working of the fuse caused by the retardation of the shell speed, as it passes through the most copper-fouled portion of the bore

In this case the bursting of the projectile generally involves the bursting of the gun itself

(c) Increase of the gun wear due to the increase of friction of the driving bands.

During the war it often happened that big guns were put out of service through encoppering after having fired but 350 or 400 rounds The output of ordnance materials was thereby considerably impaired. At a certain time this situation became very serious.

The principle of the solution suggested in October, 1916, is the following

A metallic mixture formed of a tin and lead alloy, in the proportions of 63 per cent tin and 37 per cent lead, is applied on the face of the bottom part of the shell This composition is laid in a circular manner near the circumference of the base as shown at a, a, or, if preferred it can be fixed around the shell to the rear of the copper driving band at the place marked b b This tin lead alloy can be applied in the form of rings fixed into place by soldering or better still by means of the Schoop spraying system

Under the influence of the high temperature generated by the powder gases (this temperature exceeds 3500 deg Fahr) the tin lead alloy immediately melts, its melting point being 370 deg Fahr, and owing to the extremely rapid rotation (several hundred revolutions per second) imparted to the shell by the grooves, this liquid alloy is thrown on to the walls of the bore in the form of thin drops.

When it comes into contact with the copper already deposited in the grooves etc tin forms with this latter an alloy melting at the temperature of the gun, this alloy being readily expelled by the passage of the following shells. Copper is thus dissolved by the tin As to the lead, which is a plastic metal, it adds a lubricating effect to the chemical action of tin

A few shells (3 or 4 for big guns and 15 to 20 for field guns) are sufficient to remove the entire copper obstructing the grooves of a fouled gun and by continuing firing shells provided at the bottom with a tin lead composition, copper fouling is definitely avoided It is, of course, the same when this process is applied to new guns

The photograph annexed hereto shows the base of a projectile which has been covered, purposely, with a thicker coating of tin lead alloy than necessary This shell, unloaded, has been fired on a proving ground and found after firing, tin lead alloy melting is clearly visible, as well as traces of the projection of the thin drop of melted metal

The fixing on the shell of the tin lead alloy can be carried out in several ways For instance suitable rings or collars can be made in advance to the proper size with the above alloy and welded into place on the projectile It should be noted however that the most rapid process and the one giving the best results is that known as the Schoop spraying system

This process has now been used for years in industrial practice as far as zinc, lead and copper plating

(Continued on page 210)

A Problem in Levels

How the Shafts and Workings of Coal Mines Are Kept Free of Water

By J. F. Springer

THE miner has always been troubled with the matter of getting rid of the inflowing water This has been especially the case in Great Britain in connection with the mining of coal Here in the United States the water-removal problem in the case of coal mines has not been acute over the country as a whole The reason for the difference lies in the geological placement of the coal strata in the two countries In Great Britain the coal lies deep down, while in the United States it is generally at a slight or moderate depth below the surface However, in the anthracite regions, Americans frequently have to put down fairly deep shafts to reach the coal beds It is, apparently, in connection with such mines that the tank system for the removal of water has been developed This consists briefly in lowering an empty tank into the depths below, filling it with water, hoisting it to the surface and then discharging the water It is, for all the world, like getting water out of a well with rope and bucket. In principle, then, the idea is most ancient.

A modern plant, however for the removal of water or the performance of almost any duty, immediately runs up against the necessity of making good economically There are several ways of getting water out of a mine Generally, some method is used which depends upon a pump, working with more or less continuity Pumps never discharge large quantities of water in an instant of time, but they derive their efficiency from being 'everlastingly at it' As a rule, continuous operation is a principal factor in the efficiency of numberless modern mechanical devices

A water tank may weigh a very considerable amount —17,000 pounds may be taken as fairly representative The quantity of water will weigh 30,000 pounds This is equivalent to 3600 U S gallons In addition to the 47 000 pounds of tank and load, one must think of the steel cable reaching down to the bottom This must be hoisted too, although as the tank comes up the cable weight diminishes. In the present case the steel rope would probably be 2 inches in diameter and weigh 6 25 pounds per foot. Every 1000 feet of depth would accordingly mean 6250 pounds for rope weight On the other hand, where hoists are operated in pairs, the mode of operation may be such that as one tank comes up with its load the other descends empty and acts as a counterweight The actual work to be performed by the steam engine or electric motor may thus be greatly diminished

In Panther Valley, Pennsylvania, not far from Mauch Chunk, a celebrated variety of anthracite has been mined for years In this region there are perhaps eight installations of tank hoists At Coaldale No 8 and Lansford No 6 shafts are two old water hoists. They are, perhaps, the very oldest in the anthracite region Another shaft, Coaldale No 9, has a water hoist, but the water is discharged before it gets to the surface It is, in fact, poured into a water level tunnel located below the head of the shaft. The reader may be particularly interested in a pair of water hoists located at Tamaquah Colliery, Shaft No. 14 Here there is electric motive power as well as steam

At some of the shafts the water brought up from below is used in what is called the wet preparation of coal As the coal breakers are situated at lower levels than the reservoirs at the shaft mouths, the water may be, and is, run to them by gravity

At No 14 shaft the two water hoists have the duty, in normal times, of taking out all water There are shafts, A and B, of which A is for the removal of water It is about 826 feet deep A short tunnel runs off in one direction from a level near the bottom This is the sump tunnel. It cuts across several layers of strata, which are here very steeply inclined. As an example of what the two hoists here are capable of, one may cite the record for March, 1917 In that month 20,000 tankfuls of water were hoisted. This amounts to something like 88,000,000 gallons.

Shaft No 14 is divided into four vertical compartments, each 8 x 8 feet in plan section

A steel tank used in the electric hoist will be an upright cylinder of steel plate The diameter inside is 5 feet 9½ inches, and the diameter outside is ¾ inch greater The thickness of plate is, accordingly, ⅜ inch The over-all height is about 28½ feet, but only about 19 feet, or perhaps something less, is available for holding water At the top are the four chains which are secured at quadrant intervals to straps riveted on the tank body These chains are short and serve as a means of lifting the whole at a point in the central axis. At the lower end of the tank is arranged a spout through which the water is received and discharged Above the spout and inside the tank are two flap valves These valves open upward. Naturally, when the tank is full, they are held closed by the gravity of the contained water However, there is a chain arranged in the position of the axis which connects at its lower end by two branch chains to the two valves Above, at the top of the 19 feet of water cylinder, is a small wheel around which the main chain runs. A balance weight is secured to the end. It will readily be understood, perhaps, that if, when the tank full of water arrives at the top of the shaft, the wheel is turned properly, the valves will be opened and water discharged To provide for this, a pawl is arranged to operate the wheel and it is made to do its duty by means of a fixed guide against which it strikes when the tank comes to the desired level in its upward movement. When, upon its descent, the tank enters the water in the sump, the valves will open because of the weight of the tank and the resistance of the water The counterweight mentioned will naturally keep the chain stretched.

These tanks run up and down very rapidly, the speed at Shaft No 14 being, for the electric hoist, about 1060 feet per minute However, on a lift, there will be a period of getting up to speed, say, 12 seconds. This will be followed by a period of running at full speed, which will be, say, 79 seconds in length. As the stop is approached the speed is retarded, say, for 6 seconds. Then there will be a rest period of perhaps 15 seconds. The total upward movement will thus occupy, say, 112 seconds.

Naturally it is highly desirable to know in advance just how much current a hoisting plant will consume In the present case the coal company furnished one of the great electric equipment concerns with figures covering the duty to be performed. The reply was to the effect that the current consumption required per duty cycle would amount to about 15½ kilowatt-hours. After installation, the coal company set down the total number of trips made in 1 year's operation and divided this into the number of kilowatt hours consumed, with the result that it was found that the equipment company had made no mistake

Mention has been made of the speed at which the hoists run. It is necessary that the tank shall follow a very precise path both rising and descending This is provided for by means of vertical guides arranged to form with other framework a kind of elevator well The tank has secured to it on diametrically opposite sides a number of shoes which engage with the guides.

Some actual experience with the water hoist may be of interest. Some years ago as Mr F E. Brackett tells us in an account, the pumping plant at Coleman Shaft, Cambria County, Pa., was unable to function, and the water tank method was employed as an emergency measure This shaft is some 600 feet deep and gave trouble during its excavation because of the water admitted by it. At the time when the trouble with the pumping plant occurred, water was filling the mine, partly from the shaft and partly from the mine itself, at the rate of 800 gallons per minute The pumping chamber was out of reach and would remain so until the level of the water in the mine could be lowered. Two water skips which had been purchased for use in case of an emergency were available. Each had a rated capacity of 1200 gallons. First, one of the skips was put in place to use. This required 10 hours. It was operated from 9 p.m. until the following morning

(Continued on page 210)

Left: Example of a vertical hoist used for lifting water from the shaft. *Right*: A closer view of the business end of the same outfit

The up-to-date plant for freeing a mine of water

Water Power in the Household

AS far as the United States is concerned, the water motor has come and gone At least, it was quite popular some ten or fifteen years ago, at a time when electricity was not available to the extent that it is today The small electric motor has no doubt replaced the water motor and rendered the latter obsolete except in such households and shops where electric current is not at hand, but where high pressure water supply is available

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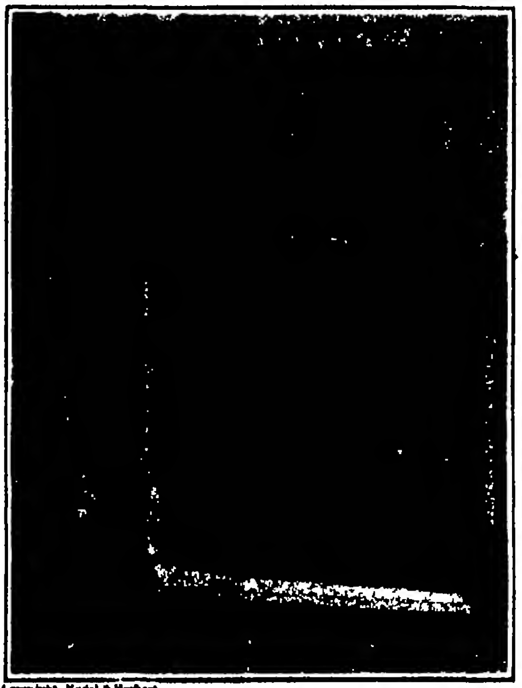
Present form of water motor employed by a French experimenter, and, at the right, his first attempt at a rotor, made with ordinary spoons

In Europe, however, there is still a field for the water motor, especially for light tasks about the household or small shop. Not so long ago a Frenchman, M. Colardeau, attracted no little attention by his application of water power for the generation of electricity used in lighting his home. It appears that M Colardeau works on the principle that it is more economical to tap the waste and drain pipes of the household than the metered water supply, and makes use of a small storage battery for receiving the periodic supply of electricity, which he thus stores and draws upon as desired.

The accompanying photographs represent M Colardeau's water motors. His first attempt took the form of a shaft and hub on which he mounted a number of ordinary spoons after the fashion of a paddle wheel as shown Later, he developed a more practical water wheel as shown at the left of the upper illustration The water wheel, which is the rotor of the water motor, spins in a brass casing which is provided with an inlet and an outlet pipe A glass face, mounting a brass bushing which serves as a bearing, enables one to notice the action of the rushing water and the spinning rotor

The second illustration shows the compact little power plant developed by this ingenious Frenchman. He is evidently making use of a magneto type of generator which is sometimes seen in laboratories because of its simple, elementary construction The water motor is also employed by M Colardeau for driving a small lathe, through a reduction gearing



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Water motor and simple magneto type generator employed by M. Colardeau for lighting his home

Potash from Texas?

SAMPLES of salts recently sent from western Texas to the laboratories of the United States Geological Survey, Department of the Interior, at Washington, D C., and of the Texas Bureau of Economic Geology and Technology at Austin, Texas, contain percentages of potash that suggest at least the richness of the potash deposits of Alsace and Germany The samples were obtained from two borings about 80 miles apart, sunk by oil companies in the "Red Beds" region of Texas, where salt beds, red shales, gypsum and other materials are associated in strata of nearly the same geologic age and general character as the potash bearing beds of western Europe The thickness of the potash bearing beds in Texas represented by these samples is unknown, however, and the questions remain to be determined whether the deposit is thick enough to furnish potash in as great amount and of as high a grade as those in Europe, or whether it is of scientific interest only and mainly important as showing that potash rich salts were actually deposited in this region and that other borings in areas where similar beds occur may discover commercial deposits.

For several years the United States Geological Survey and the Texas Bureau of Economic Geology and Technology, working in cooperation, have maintained in the field an examiner to keep in touch with companies that are drilling for water or oil in the great "Red Beds" region of western Texas, eastern New Mexico, and western Oklahoma. So far as practicable the drilling has been followed by this cooperative representative, who has made rough field tests of drill cuttings and brines in a search for evidence that the drill had struck beds of salts rich in potash and has sent samples that appeared to deserve thorough chemical analysis to the chemical laboratories of the cooperative bureaus. The problem of recognizing the presence of a thin bed of potash salt, of determining its thickness, and of identifying its precise position in the stratigraphic column is rather difficult, however, on account of the adverse conditions of observation, the methods of drilling, and sometimes the indifference of the driller Among the samples recently examined by D D Christner, the present cooperative representative at Amarillo, was one from the Bryant well in Midland County, Texas, which as shown by a rough field test is very rich in potash Subsequent accurate determinations in the laboratories of the State University and of the Geological Survey in Washington showed that this sample, which was saved by the driller from cuttings taken at depths between 2405 and 2525 feet, contained about 9 per cent of potash (K_2O) The sample consisted of red salt including polyhalite, white salt, crushed red shale, and mud, so that the fragments of red salt ground up in the cuttings probably represent a layer that is richer in potash even than the sample as a whole.

A small piece of red salt brought out from a depth of about 1804 feet in the Burns No 1 well of the La Mesa Oil Co, which is about 80 miles from the Bryant well, contained about 10 per cent of potash (K_2O)

Information as to the probable thickness of the bed represented by the sample of potash salt is lacking

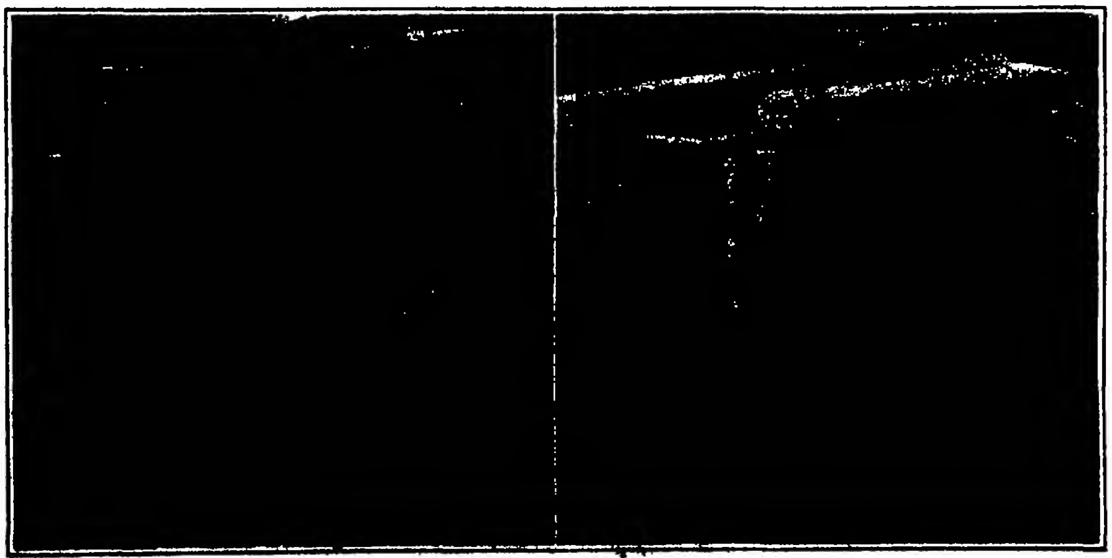
More Heat from the Fireplace

A PATENT has recently been applied for at the U S Patent Office for a fire-back that can be built in an ordinary chimney, or even installed in one after it has been built. It is claimed that this device will save one-half of the usual fuel consumption or more It is so simple that it may be installed by almost anyone

The fire back, which is shown in the accompanying illustrations at the bottom of this page, is simply a solid V shaped piece of corrugated casting that fits snugly in the back of the fireplace, and takes the place of brick Therefore, when the fire is made in one room the casting becomes hot and radiates heat in another room that backs up against the first room, providing the fireplace is cut through so as to expose the reverse side of the iron fire-back. Also, to increase the efficiency of this device, flues may be constructed in the chimney wall opening into the sides of the fireplace and communicating with the chamber behind the fire back in the other room. This chamber is provided with asbestos screen, which can be lowered or raised When lowered, heated air will be conveyed to an upper story It can readily be understood that this arrangement furnishes an ideal way of ventilating, since the intake flue contacts with the hot casting There are registers just above the baseboard in the upper rooms

The fire-back, being V shaped, can expand and contract and thus will not crack from heat, so it is claimed Furthermore, it has a sufficient thickness to render service and to radiate sufficient heat. In the event that one of these fire-backs should burn out they are about as easily replaced as a fire-back in a stove Each fire-back weighs in the neighborhood of 200 pounds

There are numerous advantages claimed for the new fire-back which is the invention of Robert Goff of Gary W Va To begin with, its inventor estimates that it will save at least 500 brick besides the saving in other materials and in labor It also saves the expense of other grates and fronts With this fire-back one fire is built instead of two or more There are no coal or ashes to be carried up and down stairs. There are no fires to watch Tests show that with this system the temperature does not rise and fall as much as with an ordinary fire, but remains at a very comfortable heat which makes the upstairs rooms ideal as sleeping rooms All in all, it must be considerable satisfaction in these days of high coal costs to know that one fireplace is serving to heat several rooms without burning more fuel than usual



Front and rear views of the newly introduced fire-back which makes the usual fireplace considerably more effective without additional fuel consumption

The Lesson of the "ZR-2" Disaster

Some Recent Facts Bearing on the Construction and Tests and the Conclusions Drawn Therefrom

By Ladislas d'Orcy

> *As we were going to press with a past issue we learned of the terrible disaster which overtook the "ZR-2" dirigible during the trial flights. We promised more details regarding the cause of the collapse of what we were given to understand was the very last word in airship design and construction. And we have fulfilled our promise by asking Mr. Ladislas d'Orcy, who will be recalled as the writer of many of the aviation articles that have appeared in past issues of this journal, to study the disaster and explain it to us in simple terms. Not only has Mr. d'Orcy explained the reasons for the disaster, but he has drawn several conclusions which should serve as a guide to future efforts in dirigible construction, both here and abroad. Incidentally, it may be mentioned that Mr. d'Orcy is Editor of the "Aviation and Aircraft Journal," one of our leading aviation journals.*—THE EDITOR.

THE two chief questions which, in connection with the accidental destruction of the rigid airship "ZR-2" (or "R-38") come to the mind of the average person are

1. What was the matter with the "ZR 2?"

2. Was her purchase by the United States Navy *justified?*

While it is yet premature, pending the findings of the official inquiry, *to state* with finality what caused the terrible disaster, it is not difficult to visualise what went wrong with the "ZR 2." Statements by survivors seem to establish pretty definitely that the big airship broke in two not under the strain of full speed trials, as had first been assumed, but that the longitudinals snapped when the helm was put hard over. The commander of the dirigible, who was rescued, has declared that at the time of the accident the ship was making 50 knots—as against 65 knots "all out." On the other hand, another survivor, Lieutenant Bateman, states that just prior to the accident the ship had made turning tests, and that two turns had been managed without difficulty, but that on the third the vessel broke her back. His statement is particularly significant in view of the fact that he was able to observe the working of the rudders as he was seated in the stern cockpit, which is aft of the rudders.

So it becomes rather obvious that the ship was turned too suddenly for the speed at which she was flying, although this maneuver might have been totally harmless at a lesser speed.

There is still a further point to be considered in formation reaching this country from men who were in close contact with the development and trials of the "ZR-2" shows that her control surfaces were overbalanced. That is to say, the balanced portion of the rudders was so large that they were extremely sensitive to air pressure so that when the ship was under way a slight turn of the steering wheel would suffice to whip about the rudders. At high speed this would naturally cause a tremendous strain on the 700-feet long framework.

It would therefore seem that the design of the "ZR 2's" rudders was faulty. This defect, which might have been easily remedied, would not have been a serious matter on a stronger ship. But the "ZR 2," far from being a strong ship, was what one may call an "extra light" vessel—a feature which borders on structural weakness. To understand the why and wherefore of the situation we must look at the *history of rigid airship development*, which takes us back to Count Zeppelin.

Germany launched her first "super-Zeppelin," a 2,000,000 cu. ft. vessel, in 1916, after fifteen years experience in this branch of engineering, in which period she built some *sixty* Zeppelins ranging all the way from 400,000 cu. ft. to 1,250,000 cu. ft. In the fall of 1916 one such super-Zeppelin, the "L-33," was brought down fairly intact in England and the British Admiralty instructed its airship designers to duplicate it. Up to that time British experience in rigid airship design and construction was limited to that obtained from a number of experimental ships that were being built after very incomplete drawings of pre-war Zeppelins. The British copy of the "L-33," called the "R-33," was only finished after the armistice, her trials taking place in the spring of 1919. Although the vessel embodied some improvements found in another captured Zeppelin, the "L-49," which had come down intact in France, it should be pointed out that while the latter ship had a useful load of 39 tons, and the "L-33" one of 30 tons, the British copy of these 2,000,000 cu. ft. dirigibles had only a useful load of 24 tons. All of which is merely mentioned to show that a painstaking copy of an engineering structure will not necessarily be identical in all respects with the prototype—although they may *look alike.*

But while the "R-33" carried a smaller useful load than her German sisterships, she seemed to be in every way as strong as the latter. How strong the hull of these ships was, the "R-34" (sistership of the "R-33") demonstrated at Mineola, Long Island, where for four days she withstood buffeting by winds, although on one occasion the anchorage fitting of the main handling rope was pulled clean out of the framework.

The success of the "R-33" class airships prompted the British Admiralty in 1918 to prepare drawings for a much larger class of airships which were to be superior to the German "L-71" type. This was the ill-fated "R-38" (the "ZR-2," as we call it) class, which incorporated numerous novel and original ideas. Now, *it should be emphasised that when this class was laid down*, all the experience the British had in rigid airship construction had been derived from *copying* German ships. The only firm which eventually was to produce a highly successful original design (Vickers, Ltd., with their "R-80") had not by then emerged from the experimental period of their work; their experience was therefore unavailable.

And what may strike the reader as particularly odd, the Admiralty gave the contract for the construction of the "R-38" (or "ZR-2") to Short Bros. of Bedford—*a firm that had never before built a Zeppelin type airship* and whose entire experience with rigids was obtained from the building of "R-31" and "R-32," which were patterned after the *plywood-framed* Schuette-Lanz type.

Here then we have, in part at least, the answer to the question which heads this article. What was the matter with the "ZR-2?" *The ship was built in a factory that had no previous experience with duralumin airship construction, and to plans which were not based on practical experience.* To cite but one instance, the well proven radial truss of the transverse frames was replaced on the "ZR-2" by a tangential truss system, the merit of which had yet to be demonstrated. In this connection I cannot do less but pay a respectful homage to the memory of the late Colonel Campbell, chief airship designer of the Admiralty, who had sufficient faith in his ideas to go up on the "ZR-2" during her several trial trips and who lost his life with the ship.

Knowing the circumstances which surrounded the construction of the "ZR 2," we begin to understand why, as one report has it "several girders were strained in the factory when as many as thirty fitters crowded on them in the course of assembly work." It is quite conceivable that workmen accustomed to the resiliency of plywood girders would do just such a thing and that their foremen, not knowing any better, would not warn them. And a 700-foot airship is such a gigantic structure that the engineers familiar with the vagaries of duralumin—whom the Admiralty had detailed to the Short Works—could not personally supervise every detail.

For the sake of completeness it may be added that when Messrs. Short Bros. closed down their airship department, the Admiralty took over their factory and completed the "ZR-2," whereupon she was handed over to the British Air Ministry.

That the hull of the "ZR-2" was structurally weak was first demonstrated on the inflation of the ship when due to unequal load distribution, several girders buckled. The failing members were repaired, but during the first trial flight trouble was again experienced from several intermediate longitudinals and transverse frames, so that it became necessary to reinforce certain portions of the framework. Details are not available as to the exact nature of this stiffening work, but one might suggest that by reinforcing certain girders others may have been further weakened. Of course, this is merely a guess.

Judging however from all that has been said before it appears beyond a doubt that the "ZR-2" was structurally weak—a condition brought about by the desire to carry the greatest possible useful load. This, as originally designed, was to be in excess of 50 tons, but it was subsequently reduced by the fitting of a bow mooring gear, not to speak of the reinforcement of the hull.

As to the second question we have placed at the head of this article. "Was the purchase of the "R-38" by the United States Navy justified?"—it would seem to the impartial observer that it was not.

Indeed, why should the Government spend abroad \$2,000,000 on a foreign-built, untried type of dirigible?

On the one hand the Navy is desirous of developing rigid airships in this country. This can be brought about only through experimentation, and it will be admitted that if the necessarily heavy financial outlay has to be faced it will better serve its purpose if the money is spent here rather than abroad. American inventive genius is second to none in the world and can be relied upon to solve the problems of rigid airship construction just as well as it has solved other engineering problems.

On the other hand, if the Navy Department—which is in charge of rigid airship development to the exclusion of the Army—wanted to have a ready-made airship of proven design, it would seem that it could have secured from Germany, without cost, by virtue of America's participation in the victory—a dirigible that would have been far superior to the "R-38." This will be seen from the appended table which gives the chief characteristics of the "R-38" and of the "L-71," Germany's largest Zeppelin, which was surrendered to Great Britain, while her sistership, the "L-72," was surrendered to France:

Type	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
"R-38"	2,720,000	695	85	2100	50(?)	75
"L-71"	2,420,000	745	79	1740	48	75

It is not generally known that while the war spoils of the United States include a great number of airplanes and engines, the lighter-than air material of Germany was entirely divided up between Great Britain, France, Italy and Japan, the United States merely playing the role of a disinterested spectator. That this was a grievous mistake, will be readily conceded by all those concerned with the development of American airships.

The Psychology of the Show Window

SOME very interesting experiments have recently been carried out at the Institute of Business Science, connected with the Commercial High School at Mannheim, Germany, concerning the psychology of the appeal made by window exhibits. The experiments were made at a large specialty shop catering to women. This shop had 15 show-windows fronting on two streets located near a main artery of traffic. In some of the windows the articles bore price tags, while in others they did not. In some one color alone was used and in others a variety of shades, again, some windows contained nothing but the articles on sale while others had picturesque settings and accessories. The results of the observation were quite striking and some were unexpected as we learn from *Die Umschau* (Frankfurt) for Dec. 25, 1920.

Dr. Lysinski of the Institute, who conducted the experiments, states that the sales of those displayed articles bearing a price label greatly exceeded that of articles not so marked. Likewise windows in which articles of various colors were shown seemed to have a greater drawing power than those in which a uniform color was used. As a usual thing greater sales were obtained from windows displaying a large variety of articles than from those showing only a few; the results varied, however, in this case. Most remarkable is the fact that those windows having decorative accessories proved to be much less effective than those without decoration. This last observation is well worth the attention of American merchants, since there has been a considerable development in this country of purely decorative features in window dressing during the last few years.

Group Medicine

A Recent Development in Medical Practice Which Groups Specialists for Diagnosis and Treatment

By Mary Ethel Jameson

SIR JAMES MACKENZIE, writing on the future of medicine, has said that medicine is becoming so complex that the general practitioner's knowledge of any particular disease is bound to be less than that of the man who devotes his whole time and energy to the understanding of that disease, and that the methods used today for the detection of disease have become so numerous and recondite that it requires special training to become adept in their use.

It seems to be a recognized fact, then, in the medical profession, that in many cases it requires the training of more than one man and more than one specialty before a true interpretation of symptoms can be reached. The physician constantly feels the need of help from associate specialists as evidenced by the practice of referring the patient to physicians in other branches of medical science, but frequently the fees of several specialists are beyond the financial reach of the patient.

Nevertheless, he is entitled to a differential diagnosis when it is possible by collaboration to determine the nature of a diseased condition before treatment is undertaken. This is not always practiced and patients are frequently victims of months of mistaken treatment before a specialist is called who finally determines the cause of the suffering

The present advances of medical science demand a revision of medical practice and the transitional state is upon us. One development most prominently demanding consideration is what is called Group Medicine

Medical journals are, at present, abounding in articles relating to Group Medicine, detailing procedure, the specialties represented, the clinics being organized in various parts of the country, and arguments pro and con this method of practice. The layman on the other hand, were he asked to define the Group plan, would probably reply that it referred to a group of public buildings surrounding a public square

Groups are generally formed for both the diagnosis and treatment of disease This is the ideal plan, although some few clinics have been organized for diagnosis alone. The group is made up of a number of physicians who are specialists in different branches of medicine. Through this arrangement each member physician has at his disposal all accessory therapeutic agencies, and the training and experience of all the other members.

The Group should comprise at least, an Internist, an Ophthalomologist, an Oto-laryngologist, a Roentgenologist, a Surgeon, an Orthopedist, a Urologist and Gynecologist, and a Laboratory Pathologist.

The patient first consults the Internist who takes a complete history of the case, making a written record of all previous illnesses and hereditary tendencies. After making a thorough physical examination, the Internist sends the patient to those of his associates who can give him light on the perplexing aspects of the case by special examinations and tests, eyes, nose, throat, spine, nerves, etc Laboratory tests are made of the secretions, excretions, and blood, Roentgenograms are made of the teeth, the gastro-intestinal tract, and of the organs of the chest and abdomen

The history prepared by the Internist is studied by each member of the group seeing the patient, and their observations are added to the record sheet with comments and recommendations. This report is finally returned to the Internist who reads the additional information contributed by his confreres and then a consultation is held, a diagnosis is determined, and the patient sent for treatment to the specialist properly qualified to treat the case or for surgical intervention Hence, as Dr L. F Barker concludes, the Group becomes a glorified general practitioner The axiom of Group Medicine is thoroughness The development of synchronized work through daily consultation and collaboration is obviously beneficial to medical practice as to other branches of scientific endeavor

As will be readily seen it is preferable that a Group should be housed under one roof in order to conserve the time of patient and physician and to assure all facility in consultation

The medical profession is by no means entirely agreed that the general practitioner is no longer able to cope with the situation, but the laity have begun to see the evils of long delayed diagnosis, and to rebel against experimental treatment. They will soon realize the value of collaboration, and will demand the services of more than one doctor before treatment is undertaken

The medical profession is not entirely agreed that Group Medicine is the best form of practice and where clinics have been established there is much criticism from the local profession Nay, more, there is often actual hostility This is to be expected, for the path of all pioneers has been a thorny one It is not long since the Mayo Brothers were accused of unethical advertising because an overzealous patient burst into print in a description of the Rochester clinic Today that clinic is the Mecca of thousands of patients, and is the ideal of the smaller clinics being established in all parts of the country

The arguments against the Group form of practice are those of a superethical profession commercialism, and exploitation of the patient.

It is an obsolete tradition that the physician should not be paid for his services, but why a group should be actuated by a greater desire for financial advancement than a single practitioner or a struggling young graduate who is willing to grasp at a straw or otherwise a patient with a fee is not quite clear The economy of group medicine is evident where duplication of attendants and equipment is avoided and time is conserved Where the usual fees for examinations by five or six specialists would total perhaps seventy-five to one hundred dollars, the Group diagnosis is

(Continued on page 210)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Excelsior!

To the Editor of the SCIENTIFIC AMERICAN

Perhaps you will accept my offering as the latest addition to your collection of scientific gems. This one, you will please note, did not come from the columns of any mere newspaper, I find it in the January issue of what, next to your own organ, I have been accustomed always to regard as the best journal of popular science. The author from whom I quote gives a very presentable account of the way in which an ice-cream freezer accomplishes its mission in life by abstracting heat from the mixture inside the can to melt the surrounding ice. But he is not content to let well enough alone he goes on to explain the role of the salt, as follows

"The salt passing into solution in the water also liberates heat, and this quickens the process by making the ice melt more rapidly, thus more rapidly taking the heat from the container"

Doubtless I ought to comment upon the gentleman's discovery of what, for want of a better name, I suppose I may call the latent heat of solution, but the fact is, in the presence of such an epoch-making innovation as that indicated by the latter part of his argument, the mere enunciation of a new principle of abstract scientific theory pales into insignificance, and even perpetual motion becomes a trivial thing not worth striving for. I refer, of course, to the author's marvelous scheme of balancing two positives to get a negative. We have always understood that two negatives make a positive, but the reciprocal theorem is a new and unexpected demonstration. If we can't spend heat fast enough, get somebody else to spend his heat; if we can't run fast enough to catch our train, get the train to run away from us and behold we shall catch it. Last spring I had a bad flood in my cellar, due to the fact that melting snow and a driving rain brought the water in faster than the drain could dispose of it. Had I but been acquainted with the principle set forth in such lucid language by this modern Faraday, I should have run a line of hose from my kitchen hydrant across the lawn, to discharge into the brook which carries off the flow from my drain The brook would have been swelled by this increment, and if I read my authority correctly, the flood in my cellar would have been relieved by precisely this amount STUPEFACTUS

The Letter W

To the Editor of the SCIENTIFIC AMERICAN

It will be noted that the letter W of the alphabet is the only letter, which in pronouncing, has more than one syllable Pronouncing it as we do, dou ble-you, it is noted that three syllables are sounded Why not simply say wu, giving it a monosyllable pronunciation same as the other twenty-five letters, This pronunciation would be more in keeping with the sound and force of the letter in the word where it is used

Just spell a few words and note the difference Way, double-you-a y, wu-a-y, when, double-you-h-e-n, wu h-e-n, and so forth.

It seems very impractical to pronounce a letter altogether foreign to its phonetic force, neither of the three syllables in dou-ble-you has the slightest relation to the phonetic power of the letter, wu seems to have almost if not entirely the full force or phonetic power

Would not therefore wu, which is very simple, clear and short be a better and more logical pronunciation?

Again, in this day of simplifying and eliminating the unnecessary, why do we persist in always using the letter U as the second letter in every word beginning with the letter Q? There is not a single English word beginning with Q that the second letter is not U and there is hardly a word that would not have practically the same phonetic force without its use.

Hanover, Pa. ERVIN S. MUMMERT

Electromagnetic Waves in Gravitational and Magnetic Fields

To the Editor of the SCIENTIFIC AMERICAN

Three physicists, one of whom fortunately is now President of the Massachusetts Institute of Technology, have stated, as the result of their experiments, that light exerts a pressure. I used the word fortunate, because the best that can happen to a school of science is to have at its head an experimenter with an original mind, for progress depends on awakening in the minds of students a real love of experimenting.

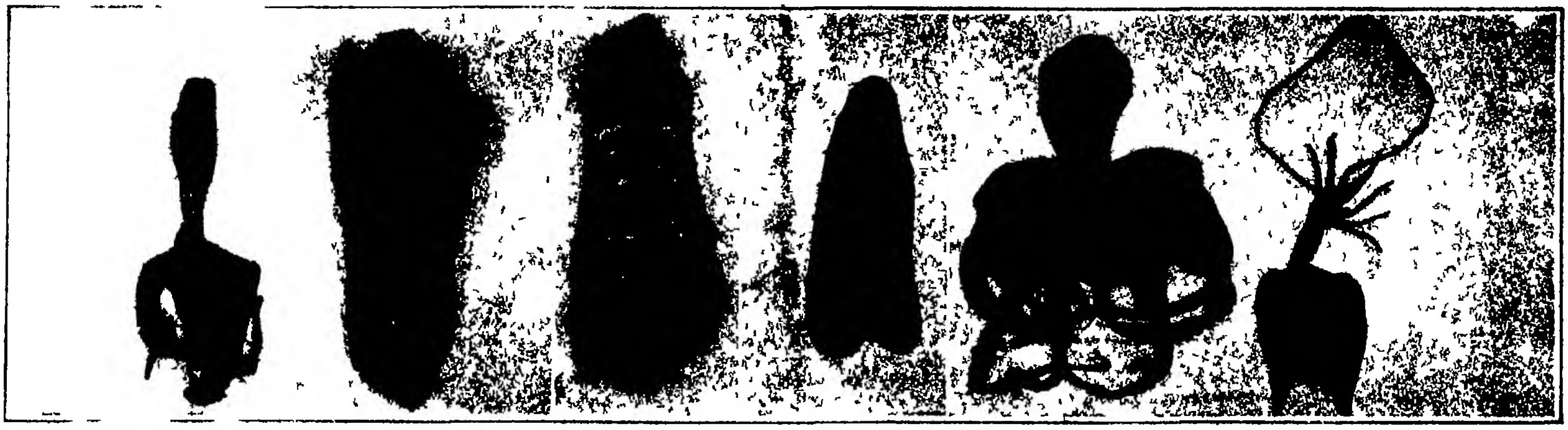
If Einstein's theory that light has mass and is therefore acted on by gravitational fields, was founded on an experiment, it was probably on those showing that light exerted a pressure Now it is impossible for the experimental type of mind to visualize a wave except in a medium having mass whether we call it the ether, the dielectric the electromagnetic medium or simply space Newton said that any man with a competent faculty of thinking must believe in a medium filling space Maxwell and Hertz always visualized a medium in their work on waves Faraday in one of his letters to his friend Phillips expressed himself as being able to do without an ether yet his lines of force required a medium in which to function

Any medium to transmit a wave must have mass, for a wave implies a displacement of mass. Any medium therefore capable of being thrown into waves must be attracted and attract, for all mass is gravitational Therefore all electromagnetic waves, whether we call them X light, visible light, infra red, or wireless, passing through the gravitational fields of bodies in space must be deflected, for the medium in the neighborhood of each must be denser Why then attribute all the deflection of light observed during an eclipse of the sun to weight in the wave? Why ignore the part played by the medium transmitting the wave? Why neglect the effect on the electromagnetic wave of the magnetic field of the gravitating body past which the wave is advancing?

Another reason why an experimenter visualizes space as having mass is its vastness compared with the bodies seen in the telescope, revealed by the camera, and with that of the dark bodies surrounding them He can only think of space as the residuum after their formation from Mother space To him the only thinkable idea of mass is that it is condensed ether and he correlates this easily with the theory that all mass is electrical by thinking that electricity is dissociated ether That an electric generator is a machine to accomplish this. The idea that electricity is dissociated ether affords the simplest explanation of Faraday's electrostatic induction, the first glimpse of which we owe to John Canton I end by mentioning a few statements by Faraday

"We may hope to bring magnetism into a bond with gravity I have a strong feeling of the existence of a relation between electricity and gravity If there is an ether it should have other uses than simply the conveyance of radiations.

Tamworth, N. H. WILLIAM ROLLINS.



1. Dried squid from China, imported by the ton. 2. Dried lobster tails, a great delicacy among the Greeks, seen from above, showing scales removed to facilitate drying 3 The same article from underneath, showing feet, etc. 4 The original Turkish kaviar prepared from the mullet. 5. The giant devil-fish, dried, on regular sale in the Greek stores. 6. The ten-tentacled ink-fish eaten fresh by the Italians

Strange creatures of the water that are eaten in Manhattan's immigrant colonies

Fish Stories That Are Stranger Than Fiction

Queer Creatures of Ocean and River on Daily Sale in Out-of-the-Way Corners of New York

By L. Lodian

FISHERMEN'S yarns are usually of such Munchausen veracity that the very announcement of them begets an incredible smile By fishermen, we mean here anglers who fish for a pastime But there are also many thousands who, by force of circumstance, "go down to the sea in ships." They, too, have their yarns, but here truth is stronger than fiction, and stranger, too. Their yarns can be read, so to speak, in the different fish-marts or markets of Manhattan, in our foreign colonies. Here you see the purely commercial in fishdom, and what you would scarcely believe if told, you can see with your own eyes almost every day of the year We refer to the many queer fish products on daily sale in old Gotham town, and we illustrate a few of them direct from the actual exhibits as rounded up one fine morning.

The devil-fish tribe, big and small, dried and fresh are never missing from the stores of the Italian, Greek, Spanish, Turko-Español and Mongol colonies of Manhattan. They range in size from the small squid to the giant cuttlefish—some of the latter are so huge that their tentacles or "suckers" reach out more than a dozen feet and could encompass an ordinary row boat.

The cuttlefish (or *kalamar*, as internationally known among the exotics) can also always be obtained, from one year's end to another, pickled and canned in its own ink Opening a container reveals a murky, inky mass, but it is quite delectable—as choice as potted lobster In fact, devil-fish flesh is at its best served up in this canned form, having already been steam cooked, and can be partaken of cold as it is, or re-heated The liquid is a reliable conservant, it is the same sepia which, in more concentrated form, has been in use since remote periods all over the globe, being particularly valued by architects and draftsmen for its permanency

Sun-dried oysters are always obtainable at Mongol stores throughout the country They never use canned oysters. The bivalves are sold either loose or in wreath form, spitted on rattan, and circled (after drying) for hanging up in stores. They are never so satisfactory as fresh oysters. They are mouthed dry, as they are, or stewed.

There is also a curious oyster-oil sold, but this is in cans, necessarily There is some oil in the oyster, and the *modus operandi* is to take the mollusk in heaps, when all but dried out, and subject it to the ordinary oil-press. It is really an oil in emulsified form, since the natural juice of the oyster, much concentrated, is there too It is a dingy, brownish liquid, of a decided oyster flavor It is used in the preparation of instant oyster broth—just add boiling water to a teaspoonful —besides its uses as a condiment for salads, soups, et al The residual oyster "cake" from the presses is braised in oil while still moist and used as food

Oyster flour, in impalpable farina form, of a cream-white color, is a most creditable product, and is always obtainable It is convenient for instantly-made stews, or oyster gravy or for sprinkling on thin bread and butter sandwiches.

Lobsters' tails, sun-dried, are a great delicacy with the Greeks, and are imported regularly There is no reason why they should not be prepared and marketed by American lobster concerns, but our own folks know not of this demand

A capital, cleanly and tasty kaviar is imported from the Hellenes and all along the Asia Minor seaboard It is the roe of the *bashra*—corresponding to our mullet fish—which is salted down, mild-cured and sun-dried to a firm compactness which makes the article almost as hard as wood Then it is steeped in and given an effective coating of beeswax This will preserve it for years, and the slightly fragrant beeswax-film will hold its faint honey like odor for as long. This is the real original Turkish kaviar (from the Arabic *kabjar*) The Russian "kaviar" is just a name borrowed from the Arabic, and the word is only used by the Russians in conversation or correspondence with aliens. Among themselves, they call it *ikra*, which simply means *roe*. With its yellow beeswax film, this kaviar resembles somewhat a flattened banana The interior has a refreshing odor and taste, and is ideal when cut into thin slices and served with sliced bread and sweet butter

Then there is the giant single-piece kaviar-roe of the southern Italians and Sicilians. This is made from the big tuna fish This big red-fleshed fish, with a body often the size of a horse, is often seen in the Mulberry plaza region But since it is too unwieldy to take into the store, it is sold piecemeal from the wagon or truck kept standing off the curb

The tuna-kaviar is sun dried to a point where nobody would ever recognize it as a dainty relish for the lunch table It resembles a piece of sun greyed shriveled wood, appears as hard and falls with a thud like wood The interior is dingy, yellowish, of most delectable and refreshing taste The kaviar is bought as a whole, at a price of about three dollars a pound It is never cut The price ranges, according to the size, from four dollars to twelve dollars, or more

A Japanese mackerel-steak, as imported, resembles a

(*Continued on page 211*)

1. Emulsified oyster-oil for flavoring. 2. Dried oysters from China, which are used as they stand or stewed. 3. A choice cut of dried devil-fish. 4. The ossified mackerel steak of Japan. 5. Trade mark from the last-named article, assuring the buyer that "a succession of illustrious sons" has made these goods. 6, 7, Eel skins, offered in many parts of exotic New York as a sure remedy for rheumatism

Some more of the curious fish-foods that may be found in the foreign shops of old New York

The Granite Gorge Bridge Across the Colorado

THE Government's slogan, "See America First," is a patriotic appeal to all of us to learn more about the beauties of the homeland before going abroad in quest of scenic wonders. And to make it worth our while to seek spectacular allurements within our own boundaries the National Park Service of the Department of the Interior is doing its utmost to make the ways of the tourist easy and pleasurable. One striking proof of this is in the form of a suspension bridge which has lately been thrown across the Colorado River in the Grand Canyon.

The wreckage of the "ZR-2" in the Humber River, near Hull

Because of the obstacles presented by physical conditions, the north side of Grand Canyon National Park, Arizona, has heretofore been well-nigh unvisited. Numerous difficulties of a discouraging and dangerous character have stood athwart the path of anyone seeking to cross the Colorado on horse or mule to reach the "north rim," as that section of the reservation is popularly termed However, persons that have been courageous enough to make the long journey from railroad points in Utah have invariably been greatly impressed with the rugged and picturesque grandeur of the Canyon when viewed from there The north rim affords observation from an altitude 1500 feet higher than any position on the south rim.

There was only one way to solve the problem of getting safely and speedily across the 420-foot gap at Granite Gorge, where the rocky walls rise nearly perpendicularly on both flanks of the river, and that was by the construction of a suspension bridge well above the swirling waters of the Colorado While Granite Gorge seemed to be the place best suited for the bridge, still the erection of such a structure bristled potentially with numerous puzzling propositions. Nature showed no disposition to lend man a helping hand to link the opposite shores which had stood apart for countless ages.

A survey showed that the bridge would have to have a span of quite 500 feet and hold its floor aloft 40 feet above the general level of the river's surface It was equally plain that the materials would have to be packed over trails for a distance of about ten miles and be carried down into the Canyon a matter of slightly over half a mile To add to the toil and the risks, the paths are made up of a series of tortuous switchbacks, and in many places the grades exceed 40 per cent It was realized from the start that these circumstances required that the structural units be as light as possible consistent with the strength and the service demanded

To insure the needful sturdiness, two main cables of special tramway plow steel were decided upon, each wire rope being ⅞ of an inch in diameter Together, these cables actually weigh 1700 pounds and they measure, from end to end, 550 feet a piece The question was how to get these heavy hawsers to the building site Originally, the plan was to apportion the load of a single cable among four mules by winding the wire rope into four pairs of associate coils—each mule carrying two of these coils and the four animals being strung together with 20 or 30-foot lengths of cable between them The intention was to place each animal in the charge of a packer with intermediate men who, besides leading the mules, were to control the intervening slack when negotiating the switchbacks.

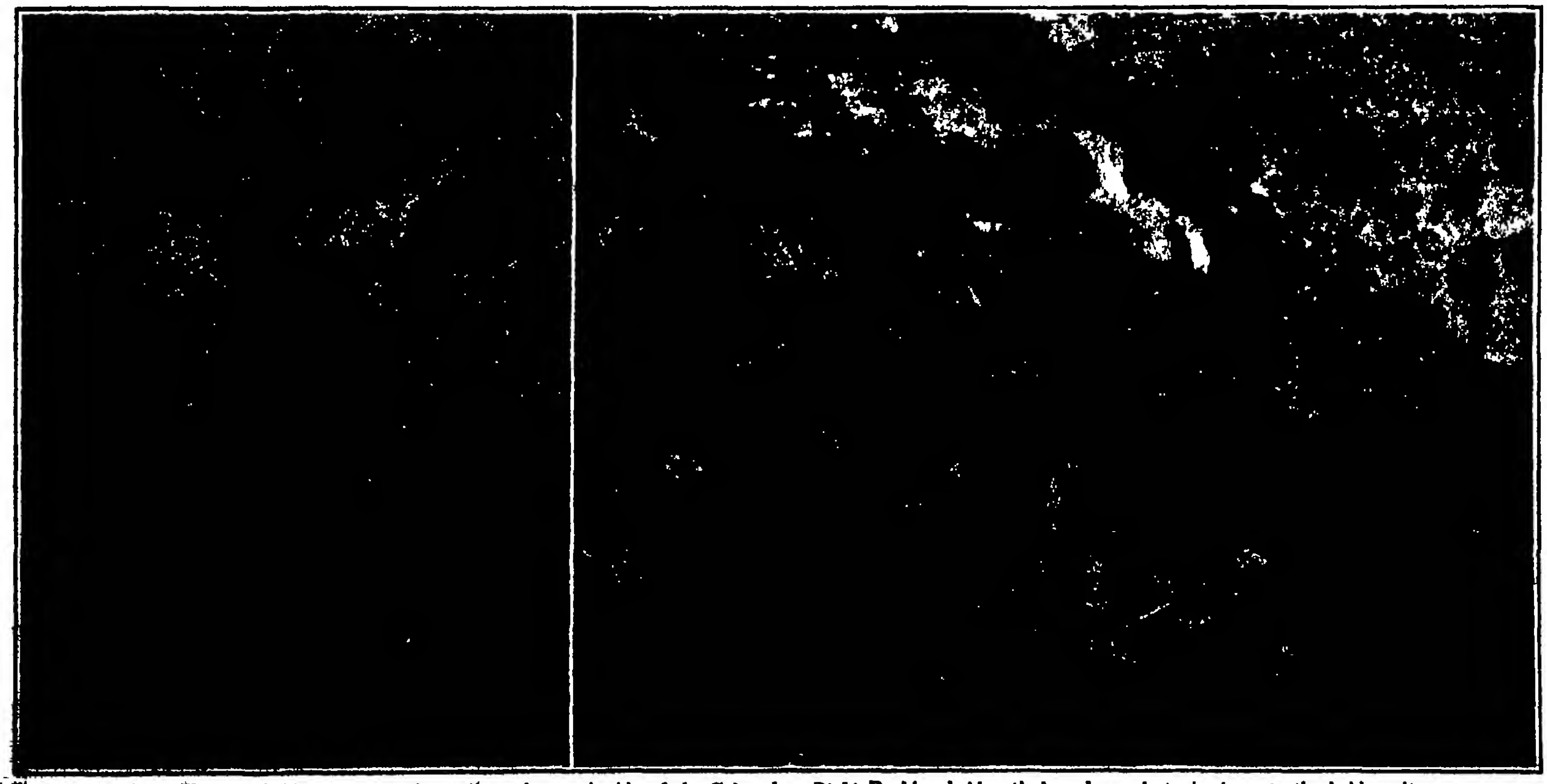
Further study showed that this procedure would hardly answer, and, in fact, it was considerably modified during the execution of the work The problem was solved finally by Superintendent D L Raeburn by placing a mule at each end of the cable and loading them separately with coils weighing 200 pounds. The remaining 405 pounds of hawser was divided among 15 men who walked 20 feet apart, the individual burden averaging 33 pounds. Reporting upon the exploit, the superintendent says "From our experience in dealing with the sharp turns on the trail, I am fully convinced that it would have been impossible to pack the whole length of the cable on mules. If attempted, the train would certainly have come into the ditch and the cable would have been badly kinked and ruined"

The preliminary work was begun at the bridge site last December under the auspices of Engineer O W Childs, who established his camp at the foot of Bright

(*Continued on page 212*)

The Wreckage of the "ZR-2"

THE various photographs of the wreck of the "ZR 2," which have just come from England, are far from spectacular, considering the quite spectacular and unfortunate ending of the great airship which was to be flown over the Atlantic to Lakehurst N J for the use of the U S Navy Indeed, instead of a huge structure of crumpled aluminum framework and loose folds of balloon fabric, the photographs show but a small amount of loose wreckage, such as that shown in the accompanying illustration. Indeed, nothing could better demonstrate the insecure construction of the usual rigid dirigible than this and other photographs, which show the framework completely broken up as the result of the collapse of the framework, the explosion and finally the impact with the water The dirigible retains its shape under normal conditions, but undue strain crumples it up into many little pieces



Left: The new bridge from up the trail on the south side of the Colorado. *Right:* Packing bridge timbers by mule train down to the bridge site

When Electricity Fires the Enamel Ware

How the Electric Furnace Has Been Introduced in the Art of Vitreous Enameling With Excellent Results

By C. W. Mehling and Jas. W. Carpenter

ONE of the most momentous improvements of recent years in the art of vitreous enameling has been made with the application of the electric furnace to the heating work of enameling. The use of electric current for heating in steel and non ferrous furnaces, in japanning, core baking, oil tempering and similar industrial operations has now been extended to the enameling process. This represents an interesting advancement over the previous ways of heating with coal, oil, or gas furnaces, and the electric installation here described has been operating for a sufficient length of time to demonstrate its practicability and its supremacy over the other types of furnaces.

Of the older methods of obtaining temperatures of from 1500 deg. to 1800 deg. Fahr. required for satisfactory enameling work, brief reference may be made to the disadvantages and troubles which have been encountered in the operation of such furnaces. With regard to the coal furnace it may be pointed out that in order to keep the temperature of 1700 deg. Fahr. it is necessary to employ an expert fireman, and even so there are times when the wind and atmospheric conditions, which have considerable to do with the draft, make it impossible, even with the very best of firing, to procure and maintain this high, constant temperature.

The most serious defect which has been encountered in the coal furnace is the muffle which periodically sags and breaks, thereby causing damage to or loss of ware by allowing the rack rests to go down. Regularly, at intervals of from two to twelve months, it is necessary with a coal furnace to renew the muffle and overhaul the firebox and furnace. This usually means a shutdown and loss of production of from two to four weeks. Moreover in the coal furnace the sulfur fumes which are injurious to the ware and frequently cause a high percentage of seconds or of job lots, are so difficult to eliminate that a certain factor in production must ordinarily be allowed for the damaged output which will be obtained from the ordinary furnace.

The oil furnace and the gas furnace have the same drawbacks as the coal furnace. They will not hold the heat in burning large ware and the bottom of the muffle burns out even faster than it does in the coal furnace. Likewise, the great variation in temperature between the front and rear ends of the oven usually reduces the actual space which may be productively used in burning. Such ovens are handicapped by the time required to bring them from a cold condition to operating temperature, and part time operation is practically impossible. Also the fuel supply of coal and oil furnaces is dependent upon railroad and labor factors which are not entirely dependable. The space occupied by the older ovens is greatly increased by the fuel storage room needed.

In sharp distinction with the preceding faults of the older type furnaces, it may be indicated that in the electric furnace there is no trouble with the muffle and the subsequent loss of ware by the falling rack rest, since the electric furnace has no muffle and the rack rest is built right up from the foundation. Furthermore, the even distribution of heat is a feature which can be obtained only by the electric installation and the furnace can be loaded from the rear wall right up to within six inches of the door and burned down to a finish, and the operation leaves a clean white enamel without spot or mar. Atmospheric conditions, of course, have no influence with the electric furnace as it needs no draft. Let the weather be what it will, it is your obedient servant providing sufficient electric current is available for its operation. Set the furnace to operate at 1700 deg. Fahr. and you will have 1700 deg. Fahr. regardless of the sunshine, rain or wind.

The cost of the electric furnace is, obviously, considerably higher in original investment than any of the other types, but the difference in maintenance cost, saving in space and cleanliness soon make the difference in price a matter of secondary importance. The fuel cost on an hourly basis for the electric oven is likewise higher, running nearly double that of coal, gas and fuel oil for 24-hour day operation. However, the additional output of the electric furnace as determined by relative tests shows that the actual cost per pound of metal handled will compare very favorably with any other form of fuel. When the electric furnace is able to handle at least 170 heats in ten hours of No. 22 gage steel against 150 heats of the same material by the coal furnace, and with 25 per cent greater weight per charge, the comparison in actual cost of fuel assumes a different proportion and value actually in favor of the electric installation.

Electric furnace now being employed in the firing of vitreous enamelware and resulting in a better product at a lower production cost

The oven in which we are interested is the first commercial installation of such an equipment in the United States, and has been installed within the past six months in a St. Louis factory. The record established thus far has fully justified the engineer in the adoption of this method of furnace heating.

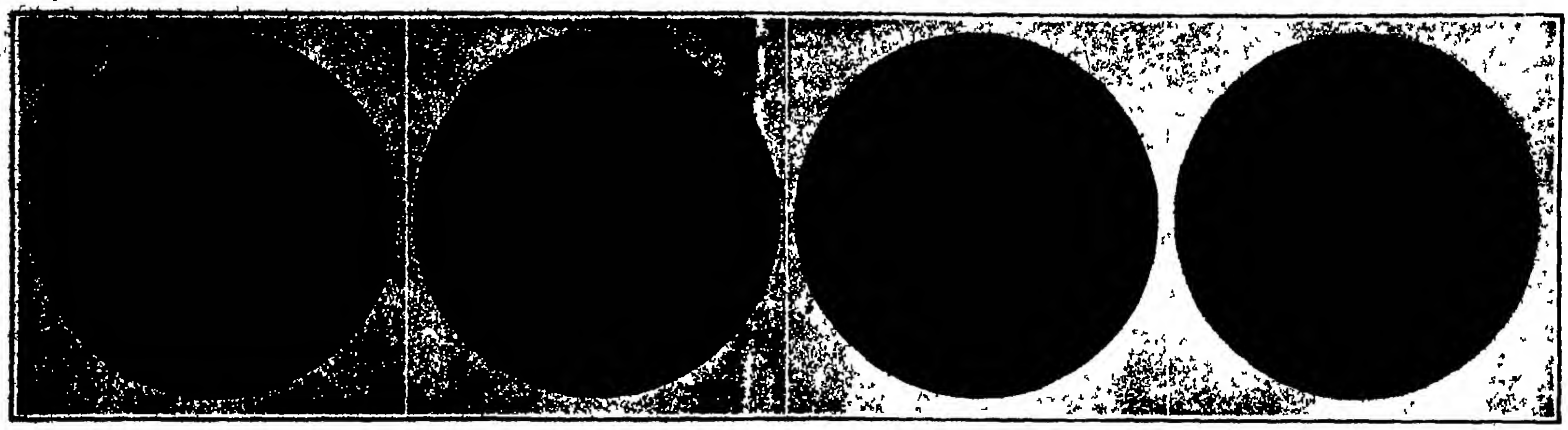
The furnace is located in one corner of the enameling shop and the power supply is the transformer substation located in an out-of-the-way place on the roof of the building some forty feet away from the furnace. The power is from the same supply that furnishes the power and lighting for the building through an underground 13,200-volt cable from the lines of the local power company.

The furnace measures approximately 12 feet 11 inches in depth by 7 feet 8 inches in width and 7 feet 4 inches in height in overall dimensions. The actual enameling space is 4 feet wide by 2 feet high by 10 feet deep. The roof is curved somewhat so that the actual height is 30 inches in the center and 26 inches at the sides. The heat is obtained from ribbon nichrome wire woven up and down on each side of the furnace over special hanger brick in a lattice-like arrangement. The winding on the lower sides is double while that on the upper sides is single except for about 22 inches back of the door, where a double winding is installed to make proper allowance for the escape of heat when the door is opened and closed for loading and unloading. The nichrome wire is approximately ⅝ of an inch wide and .05 inch thick. There are six heating elements in the furnace and micrometer tests made after sixty days' operation showed no physical change in the windings. Similar nichrome elements for heating, etc., have been in use for over three years without apparent change.

The furnace brick work is built up in the following fashion. There is first a four-inch course of common firebrick and the special hanger brick for the support of the heating elements are incorporated as a single row in this course. Outside the firebrick there is a 9-inch course of insulating brick and then a 4-inch course of common red brick. It is proposed to cover the entire furnace with a coat of asbestos from two to four inches thick. The door is about 4½ feet wide by 3 feet high and is made of insulation brick and steel frame. Usually special monel metal racks are used in carrying the heating work to reduce the area and weight of metal and prolong the life of the racks.

The electrical equipment for the furnace consists of the ribbon windings which have a maximum rating of 150 kilowatts or roughly 200 h.p., and are operated on 220-volt, 3-phase, 60-cycle current. Adequate protection for them is provided by special fuses. Control and record of temperature is obtained by two thermo-couples connected through the walls of the furnace, one of them measuring the temperature of the winding and the other the temperature of the air in the furnace. In addition there is an automatic electric control panel installed at one side to the rear of the furnace containing contactors and automatic switches providing for automatic control of the furnace, and one electrically-operated automatic temperature recorder and control apparatus. The latter gives a recording chart showing the temperatures of both the ribbon and the air and permits of variation in the control of the furnace so that it can be operated at any temperature up to 1800 deg. Fahr., for which it is set. The nichrome windings in the furnace are connected to the control apparatus and to the transformer substation by heavy copper wire installed in conduit, and the entire oven installation is on a separate oil switch which gives it individual control from the lighting and power load of the factory.

The results thus far obtained have been highly satisfactory, particularly with regard to the quality of the output and the speed with which the oven can be brought to temperature. The electric furnace can be brought from stone cold condition to 1700 deg. Fahr. in 12 hours. For similar heating of a coal furnace it would take up to 48 hours, for an oil or gas furnace about 24 hours. The electric furnace has been shut off at 5 a.m. with temperature at 1700 deg. and cut in again at 6 p.m. at 1200 deg. and in forty minutes it has been ready for work at [illegible] deg. The production obtainable during an hour is [illegible] pounds of ware and racks with the use of 150 kilowatts per hour, the number of charges being 24. This means [illegible] pounds of enamel ware at a cost of [illegible] for the electric energy used for the furnace.



Chrome alum; perpendicular lines the dominating effect

Lead nitrate shows a lattice pattern

Octahedral crystals of bismuth nitrate

Potassium nitrate gives inclined axes

The various patterns in which some familiar substances crystallize

Natural Designs Artificially Produced

THERE is nothing dry and uninteresting in nature every thing in the animate and in the inanimate world should tend to awake our loving observation. The stones in the interior of our earth should receive as much of our time as the flowers in the fields, the glittering crystals, the gayly colored butterflies, or the mysterious denizens of the deep.

But since the organic things are much more in evidence, and since their beauty is often very striking so that they are seen at considerable distances, the inanimate objects receive far too little attention. But the regular form and cleanliness of the mass are here far more prominent than in the organic world Every thing is pure about the crystal. All foreign materials have been rejected by it. All similar particles have joined together to produce a harmonic whole, mathematical in its regularity, and wherever the same substances may be found they will always be bound together in the same way Such is the law of crystallization.

It is indeed a wonderful law which reigns supreme over this dead material. It demands that all chemically pure substances not only have all their constituents, but that they assume a definite shape as soon as they make their appearance in the solid state. One is almost tempted to say that the ideal basic form of nature is developed by the crystal, especially those which were enabled to grow independently and without distortion. But the majority of minerals consist of a mixture of various substances and these do not possess any regularity of form.

The greater part of the crystals are gradually deposited from solution either on cooling or on evaporation of some solvent. The *slower this process*, the more perfect will be the final product.

All crystallizable substances have the characteristic of growing in all directions of their faces if the substance is continually and evenly deposited on them The rate of growth, in the various directions, is not uniform, and this gives them their definite shape which is always constant, no matter where or under what conditions they may have formed. This distinct shape can usually be noticed under the microscope at inception When deposition begins in one direction the crystals never form uniformly, they are distorted.

Imperfect crystallization is by no means uncommon This is produced through a too rapid deposition, that is, *a too rapid growth of the crystal. Then crystallization* takes place in one direction with excessive speed. In this way barred, crossed, or star-shaped crystals are

(Continued on page 212)

Left: Aphrophora quadrinotata, the spittle insect. *Right:* The larval deposit of the spittle insect, slightly enlarged

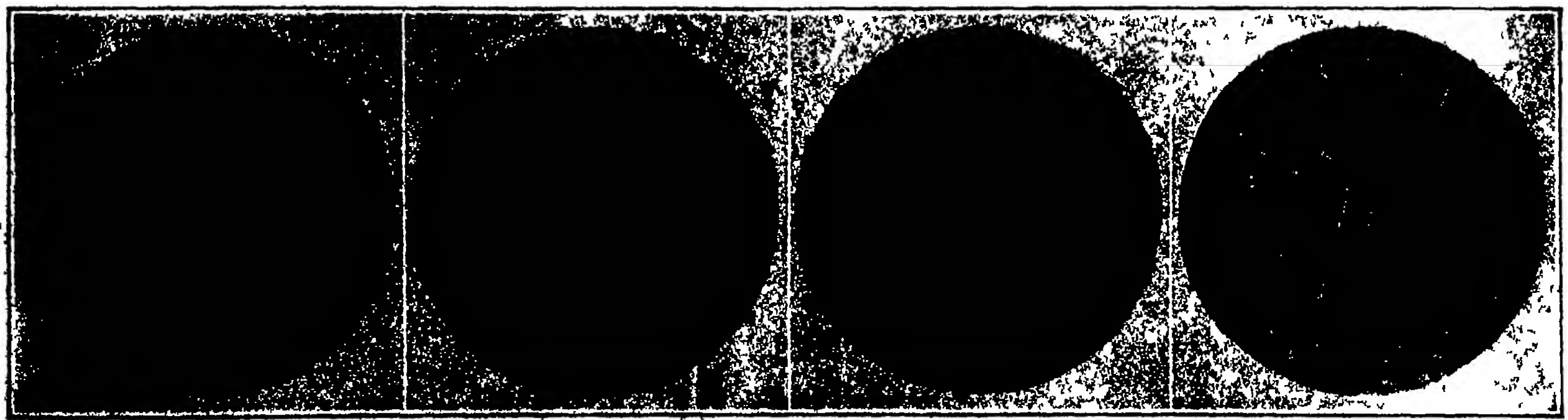
Explaining a familiar mystery of the wet meadows

The Spittle Insect

IN the fields and meadows, while seeking the solitude of nature during the summer months, white foamy masses are often seen on the grasses This is often called "frog spittle" But neither man nor animal has expectorated this foamy ball upon the plant It is the work of a larva from the frog hopper or spittle insect which lives under this mass of bubbles and withdraws plant sap with its beak from the grass upon which it sits, we learn from careful observation

The larva remains hidden in the frothy mass and it can only be seen when this is spread out The tiny mite which is then uncovered is soft bodied and pale green in color In the fall the female of this species lays its eggs on the stems of the grasses, and next spring when the eggs have hatched and the larva has made its appearance, it migrates to some soft shoot bores its beak into the tissues, and begins to suck the sap The white foam begins to form about the animal The larva takes from the sap all necessary food material required for its bodily growth, and gives off the almost clear unused sap In this state no bubbles are to be seen They are formed through the continual expansion and contraction of the abdomen which brings the air into the fluid mass It seems very probable that the abdomen, during this process, is also used for breathing In this mass the larva lives until the last molt.

This froth cannot be considered *a protective medium* from enemies since wasps and other insect robbers know full well what to find in the foamy coating, and they seek it diligently as a dainty morsel



Potassium ferrocyanide; massive crystals with delicate floral designs between them

Mercuric chloride develops sheets somewhat resembling ice flowers

Potassium bichromate gives the suggestion of seaweed

Ammonium bichromate has the seaweed effect but is more massive

Other salts abandon the straight line and give elaborate floral effects

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Left: Motor truck making a corner with a trailer train loaded with ashes. *Right:* Train load of ashes being dumped at the municipal dump, City of Indianapolis

Front-Wheel Brakes for Trucks

THE element of speed in motor transportation entails a grave responsibility on the engineer in insuring the safety of the driver, of his vehicle and load and of the pedestrian. In this connection the factor of stopping efficiency is of paramount importance.

Braking efficiency may be easily confused with stopping efficiency. As developed by a leading authority on brakes, the brake which has the capacity to lock the truck wheels is wonderfully efficient in braking capacity, but braking performance of this character is prone to prove disastrous when applied to the road wheels of an automotive vehicle where stopping efficiency is the prime consideration. It has been a simple matter for rear axle makers to design a brake of such character as to avail itself of all stopping capacity afforded by the road contact of the rear wheels, but once this point is passed the dangerous rear wheel skid is induced.

The securing of further stopping efficiency, therefore, is only to be obtained through additional road contact and this in turn is only afforded through the front wheels of the vehicle. Designers of railway equipment soon discovered this point and now we find a brake shoe on each car wheel.

Front wheel brakes are not an experiment. They have been in use on numerous European cars for years and their complete efficiency has been thoroughly demonstrated. The chief obstacle in the way of their general adoption has been the complication presented in their design in applying them to the front axle when the road wheels must oscillate from the axis of the axle in the steering of this vehicle. A casual study of the elements embodied in the design of the front wheel brake as applied to the Shuler line of front axles will serve to convince that the design affords a wonderful simplicity, insuring both the efficiency and economy so essential.

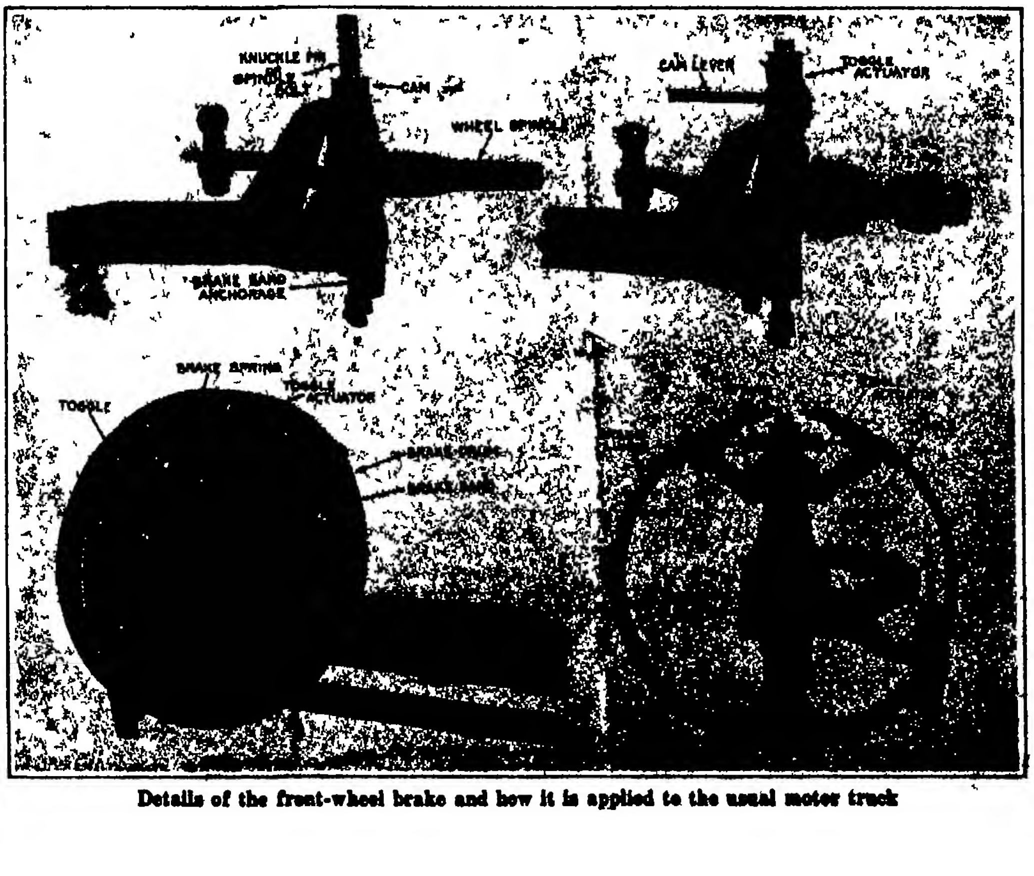
Assuming that brakes are attached to all four wheels of the car or truck and that the braking capacity at each wheel is equal, a simple computation will show that the application of braking effort on all four wheels simultaneously will stop the vehicle in half the distance as will brakes applied to but the two rear or two front wheels independently.

The illustrations herewith shows the simplicity of construction of this front wheel brake and the mechanism by which the brake is operated.

The brake lever has a spiral cam surface in its face, the exact reverse to that in the upper bushing supporting the knuckle pin. The cam lever rotates freely about the knuckle pin and is mounted above the cam lever in such a position so that it can be raised by it. The operating sleeve is free to slide up and down lengthwise of the knuckle pin, but is keyed to the pin in such a manner as to force it to rotate with the pin around the axis.

A pull of the cam lever causes it to rise upwards on the knuckle pin through the action of the cam and forces the operating sleeve in the same direction, raising the toggles and spreading the band. The cam lever, which is free from any other influence than the cam surface remains constant with the axis of the axle proper, whereas the operating sleeve slides on the back portion of the cam lever to any position impelled by the turning of the knuckle and wheel in the usual steering operation.

As the actuating mechanism is raised, the toggle lever expands the brake band and rotards the brake drum motion in the customary way. There can be no interference between the braking and steering action and adjustment to compensate for wear is obtained by altering the length of the toggle arm, which may be done with little trouble by the average automobile mechanic.



Details of the front-wheel brake and how it is applied to the usual motor truck

Ash Hauling Cost Reduced

ON a certain date the contract for hauling Indianapolis ashes expired. The contract had been held by an Indianapolis contractor who submitted a new bid. Beginning the new year it would be worth $84,000 a year and $54 an acre for annexed territory to continue the ash hauling work for a period of five years. That was the straw that broke the camel's back. The city immediately cast about for a new beast of burden. The result was the purchase of four 5-ton trucks and 25 trailers. This fleet went to work immediately. That was in the winter. Since that time, the motor equipment has gone faithfully along, writing itself off the books. During 1919 a total of 115,286 cubic yards of material was collected and hauled to the dumps. Figuring seven years as the life of the trucks and trailers, the item of depreciation for one year is approximately $8286. Operating costs (including oil, gasoline, tires, repair parts, labor on trucks and trailers) totaled $12,305. Allowance of 6 per cent interest on the balance of the cost of the equipment adds $2784 to the year's total. Then throwing in a payroll of $53,063 the total cost for 1919 amounts to $76,439 which, on the basis of 115,286 cubic yards of ashes collected, gives approximately 66⅓ cents as the haulage cost per cubic yard.

But the real advantage of the motorized and city controlled ash-hauling system is not at once apparent in these figures. Recall that the renewal term proffered by the private contractors was not a flat figure of $84,000 but rather that amount plus $54 an acre for annexed territory. Since taking over its own ash hauling job, the City of Indianapolis has extended its service facilities to a greatly enlarged territory which, had it been annexed under the terms of the tentative new private contract, would have run the expense of that service very close to $100,000.

The Indianapolis method of ash collection is as follows: Horses, hauling trailers, wend through given alley routes collecting ashes from house to house. The loaded trailers are then left at predetermined street locations, where empty trailers are waiting. The horses are hitched to the empties and lose no time getting out in quest of new loads. Meanwhile motor truck tractors en route to the ash dumps couple the loaded trailers to the trains and continue on their respective ways.

A New Profession

(*Continued from page 196*)

this connection come up for rather extensive treatment in our general course in landscape gardening." In 1918 the Forest Service published two inspiring bulletins by Professor Waugh, as collaborator "Recreation Uses on the National Forests" and "Landscape Engineering in the National Forests." He has also outlined a plan for the development of a village at Grand Cañon, Ariz.

A synopsis of principles involved may be gleaned from Professor Waugh's much detailed statements. Three closely related objectives of the landscape engineer are To preserve the native landscape in its pristine beauty, to make it physically accessible to the largest number of persons, and to present its beauties in the most logical, intelligible and convincing manner A principal enemy of the landscape is fire, hence the opening of trails for its fighting is most vital. Three specific fields of the work in the profession are. The lay-out of special permit areas for summer colonies, the location of trails, and the location and betterment of ranger stations and their grounds

Summer-camp areas are in great demand In the National Forests sites for cottages may be leased for a long period for a small sum Considerable colonies of these homes, to which the builders return with their families each season, require a well thought-out plan in advance, otherwise the first comers fill up the choicest sites bordering a mountain stream, running through a narrow valley, or encircling completely the shore of a lake, often cutting off access to the water front or to desirable future trails leading to colony sites to be later developed The perimeter of a lake, for 50 to 500 feet inland, should be kept open for the common use of all and access allowed at intervals between building lots. Where suitable building spots, as in more open country, are many, home sites may run up to the maximum of 5 acres per family One acre, represented by a plot 200 by 200 feet, or 150 by 267 feet, is a good average Four houses to an acre should be the limit of crowding. It is better to open new avenues and establish other centers of community convenience farther on than to permit over-large or congested summer colonies. The checkerboard arrangement of uniform lots is undesirable from an esthetic point of view, though an irregular division requires skill Each lot should contain a spot level enough for a building The entire hinterland will be at the disposition of the cottagers for their pleasure, outside of the area reserved for their private use Proper sites should be reserved and provision made for such utilities as boat landings, store, post office, ranger station, water supply and sanitation

Trail location is complex A short and direct route serves expediency, and trails must be suitable for timber cutting and fire fighting, as well as to accommodate tourists, the selection of low grades facilitates climbing and promotes safety, the limitations of funds calls for courses having the least excavating, filling and bridging, yet the landscape engineer's problem is further complicated, for he considers beauty values. Without neglecting utility he must connect scenic points and have them appear, where possible, from points where a major change of direction or grade mark the divisions of a trail into what some clever person has called "paragraphs." Sometimes timber must be cut to open up a hidden sight, leaving other trees to frame the picture at view points the road should be widened for parking vehicles and benches set for pedestrians to rest; signboards should point to the view and name it, or give facts about it. A near-by beauty spot appears to best advantage as seen from an up-grade: while a distant outlook is at its best from the top of a grade

(*Continued on page 209*)

Addition of Stiffening Rod Improves Starrett 48" Micrometer Caliper Gage

The well-known Starrett line of No. 24 Micrometer Caliper Gages has recently been supplemented by the addition of a new model, No. 24-A, which is similar to the 48-inch size of No. 24 excepting that to No. 24-A has been added a stiffening rod reinforcing the entire length of the beam, and also has jaws 4 inches deep in place of the 2-inch jaws with which the No. 24 gages are furnished in the 12 18, 24 and 36-inch as well as 48-inch sizes. The beams are graduated in 8ths, 16ths, 32nds and 64ths. The head or jaws carry auxiliary tram points and may be removed so that the beam may be used separately as a rule. Attachments are also made to slip on and off the ends of the caliper so they may be used to set inside or outside callipers for making close or drive fits, etc The inside callipers are set against the inside face of gage and resting on the seat of the attachments, keep them in perfect line. The outside callipers are set against an extended seat of the attachment in line with the inside faces of the gage so that both inside and outside callipers may be set to agree with each other This gage may not only be set by the graduated beam but varied by the micrometer adjusting nut to read in thousandths. The beam and attachments, like the jaws, are hardened and ground, insuring long service.

Starrett Micrometer Caliper Gages No. 24 and No. 24-A afford greater scope than any other tool of their kind made, and are widely used in many industries for the accurate measurement of relatively large dimensions. The construction and application of these gages are clearly illustrated on page 106 of the new Starrett Catalog No. 22

Starrett Tool Makers' Buttons Now Available in 1-Inch Size

From the many machinists and tool makers who have found Starrett .300-inch, 400-inch and 500-inch tool makers 'buttons a time-saving convenience—especially on jig and die work—has come a strong demand for these buttons in a 1-inch size. In response to this demand, The L. S. Starrett Company now offers Starrett Toolmakers' Buttons, Set No. 494-D, hardened, ground and lapped square with the end to the 1-inch size. A *full description of these buttons*, with illustrations, is given on pages 116 and 117 of the new Starrett Catalog No. 22. Published by The L. S. Starrett Co., Athol, Mass.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

CONTROL.—W G LANDON, 91 Hope St Stamford, Conn This invention relates to a control which is equally applicable to lighter and heavier-than air" machines and in the latter case may be applied to any desired type of plane. The device includes a duplicate set of controls, each set comprising a rudder, elevators and ailerons, operated by two independent joy sticks in the fuselage and means extending between the joy-sticks for detachably connecting and synchronizing the movement thereof

Pertaining to Apparel

GARMENT FASTENER.—F D LAVALLE, 2529 Cambrilling Ave, Bronx N Y The invention relates to separable fasteners for garments, especially designed for use on ladies underskirts. Among the objects is to provide a simple device which is readily and quickly operable to effect the fastening or unfastening of a garment or other article to which it is applied

WEARING APPAREL.—A BLATTNER, 708 Penn Ave, Pittsburgh, Pa. The object of this invention is to provide means in connection with dress shirts for holding the tails of the shirt down in proper position, and for holding the entire shirt in settled position on the body A further object is to prevent bulging of the shirt at the waist line especially with trousers worn without suspenders.

DIVERS' SANDAL.—W C ZASS, Bethesda Md More particularly the invention relates to divers footgear in the form of a weighted sandal to be worn over a gum or similar boot so that during periods between diving the diver may slip off the sandals and walk in the boots without undue wear of the foot portion of his suit and without the necessity of having slippers for this purpose

SHIRT.—H H REINHOLD, c/o First Natl Bank, Los Angeles, Calif An object of this invention is to provide an article of the character specified having interchangeable cuffs and interchangeable front plait, arranged to be connected to the shirt body or disconnected so that these parts which become soiled most easily may be removed and replaced by clean parts.

GARMENT.—A F SACKETT 1536 N Topeka Ave, Wichita Kans. The invention particularly relates to garments of the overall type An object is to provide a garment which will freely easily and automatically adjust itself to all movements of the body and which will relieve of any strain or pull the shoulders or other parts not well adapted to bear the same and evenly distribute any such pull or strain over parts best adapted to bear the same

GARMENT FASTENER.—E. J F WEIG, 85 Post Ave, New York N Y This invention relates to a device for fastening a turned up collar of an overcoat to maintain it tightly closed, the device is also adapted to be used about the sleeves at the cuffs or for tightening trouser legs More particularly the invention relates to a device in which a strip of material, usually elastic is employed provided with pointed hooks for pentrating the garment.

Electrical Devices

ELECTRICAL CONNECTOR. — L. VAN ATTEN, 170 Spring St, Ossining N Y An object of this invention is to provide a connector which can be securely locked so as to prevent possibility of accidental disconnection due to vibration or other causes. The connection is especially designed for use in restricted areas, such as the inside of motor cases and such places as have restricted free length of cable or wire

ELECTRICAL FIXTURE.—F L. BUTLER 740 E. 36th St, Chicago, Ill An object of the invention is to provide an electrical fixture in which means is provided for insulating electrical conducting means from the parts maintaining such electrical conducting means in position A further object is to provide a device that is ornamental in appearance durable in construction and thoroughly practical commercially

Of General Interest

CABINET.—G POLL, 1918 Harmon St., Brooklyn, N Y This invention relates to a cabinet which shall be strong and durable yet not cumbersome in construction. The cabinet is especially adapted for use by oculists, and is constructed to receive a tray for receiving the numerous lenses utilized for eye testing the entire tray being readily removable for the purpose of cleansing, etc.

SOLID NON HYGROSCOPIC IRON SALT AND THE PREPARATION THEREOF.—O ROHM, Darmstadt, Germany The invention relates to a process for the production of non-hygroscopic iron salt especially suitable for tanning purposes, comprising concentrating the water solutions, which contain iron, chlorin and sulfuric acid in the proportions by weight corresponding to the formula $Fe\ SO_4\ Cl$, under reduced air pressure until a water content of 37 per cent is reached

CROCHET COTTON OR WOOL HOLDING DEVICE.—W H CROWELL, 373 Pacific Ave Detroit, Mich Among the objects of this invention is to provide a convenient means for supporting the ball of wool or cotton so that

A PERSPECTIVE VIEW OF THE INVENTION

it is kept clean and can be drawn from the ball or roll as used A further object is to provide a device which is light and can be supported on the wrist of the user and is made with a handle in which the crochet hooks can be stored when not in use.

CLOSING GUIDE FOR COLLAPSIBLE TUBES.—G H NEIDLINGER, c/o Peerless Tube Co Bloomfield, N J The invention relates to means for indicating the relative position of the closing machine with the printing on the collapsible tube in order that the closing machine may be applied parallel to the bottom end of the tube, and to cause the folded end to assume a folded position perpendicular to the axes of the tube.

PIN TICKET.—J R. BATES, 1764 Amsterdam Ave, New York, N Y An object of the invention is to provide a pin ticket folding fastener which is composed of a single piece of wire and which may be operated to puncture goods and secure the ticket in place or may be positioned over the edge of the cloth or other article without scratching or marring the cloth or other articles.

WATERPROOFING COMPOSITION — T BOSSHARD, 385 Cornelius St, Brooklyn, N Y The object of the invention is to provide a method of treating bags or woven material such as are used to cover food or confectionery, in such manner as to make the material moisture proof The composition includes gelatin, water and glycerin in proportions of one-half pound gelatin, eighteen ounces of water and nine ounces of glycerin

DISPENSING FAUCET.—A B. GREEN, 161 7th St, San Francisco, Cal. The principal object of the invention is to provide a root beer dispensing faucet which through various passages and combinations of said passages will allow the component parts of root beer to pass through the faucet singly or in combinations. A further object is to provide means by which certain combinations are passed through the faucet in a fine stream while others are passed without any pressure.

Hardware and Tools

LATCH.—L. W HOLLAND, Pleasant Hill, Mo. The invention has for its object to obviate the necessity of slamming a door in order to insure its latching In overcoming this use is made of a slidable latching dog which projects normally in such a position that it may be engaged by the latching lug so that the weight of the dog alone is raised prior to the engagement of the latch to hold the door closed.

PIVOT SPRING HINGE.—O KATSCHINSKI, 230 W Superior St., Chicago, Ill. The object of the invention is to provide a spring hinge which may be used for double swinging doors without injuring the door or the support and with assurance that the door will set in the manner desired. A further object is to provide a spring hinge which does not require expertness in mounting, and spring driving mechanism which is adjustable.

COMBINATION PADLOCK.—W S. MCADOO, 4114 W 21st St., Chicago, Ill. An object is to provide a padlock having a shackle which is held positively by a removable pin and which is provided with character bearing wheels or rings that are countersunk, so as to prevent injury to the wheels by a blow from a hammer or the like. A further object is to provide a lock in which there are no projecting parts or openings that permit the use of tools to put the lock out of commission

CASING SPEAR.—W J SHEEHAN, Santa Paula Cal. The invention relates to tools used in drilling wells and more particularly to fishing tools. One of the principal objects is to increase the scope of usefulness of a casing spear and eliminate a multiplicity of separate and individual tools. Another object is to provide a casing spear with means rendering the same reversible to permit of its use either as a "jar up" or "jar down" spear

SHADE BRACKET.—W H. BOOTH, 425 W 146th St., New York, N Y The object of this invention is to provide a bracket capable of application to the side strip of the window sash without any extraneous securing means, such bracket being capable of retaining the ends of a pair of shade rollers in applied position, thus avoiding the necessity of two separate brackets, where shades of two colors are fitted to a window frame

SPRING SLIDE DOOR JAMB OR LATCH.—F CLARK, 6 Calle de Juarez 82, Durango, Mexico. One of the objects of the invention is to provide a door jamb or latch having a relatively movable member which when used in combination with a locking mechanism carried by a door, may be actuated to permit movement of the door without the necessity of actuating the locking mechanism carried by the door

COMBINATION AUTOMOBILE TIRE TOOL.—F EMMENEGGER, 2644 Chippewa St., St Louis, Mo The invention relates more particularly to a combined tire tool adaptable for

A PERSPECTIVE VIEW OF THE TOOL

use in taking off and replacing tires, and is applicable alike to what are known as 'straight side' tires in demountable rims, and clincher' type tires of other rims.

RIVETING TOOL.—A I ALBRIGHT and F. L. MYATT, c/o Pope Hardware Co., Monroe, La. The invention particularly relates to rivet holders adapted to hold the made head of a rivet while the other end is being headed. The object is to provide a holder which is especially adapted for use with channel members or the like as for instance, in the assembling of end cross members and the side members of an automobile chassis.

COMBINATION BARBECUE IRON AND GRATE.—A. H. FROOM, Santa Maria, Cal. This invention is particularly adapted for camp use or where it is desirous of cooking over an open fire. The principal object is to so construct the device that it may be raised or lowered according to the heat of the fire, and that may be manipulated to turn the edibles over so as to present all sides to the action of the heat.

DECK PLATE KEY.—W MEYER, Genl. Delivery, Tarpon Springs, Fla. The invention relates to a key serving for turning a deck plate by engaging the pins of the key in the pinholes of the deck plate. The general object of the invention is to provide a key in which the members carrying the pins may have relative movement for positioning the pins at different distances to suit the pinholes in deck plates of different sizes.

LOCK.—A. LASKI, Fairfield, Conn. This invention has for its object to provide a cylinder lock for use with mortise locks, for controlling the lock from the opposite side of the door so that upon which the mortise lock is placed, as for instance, in locker doors where the mortise lock is arranged on the inner face, and the auxiliary lock being embedded in the door and operable from outside the door and having means for controlling the mortise lock.

SHEET COUNTER.—B. MORELL, 44 W 18th St., New York, N Y The primary object of the invention is to provide a counting caliper or counting gage, for determining the number of coupons or tickets in a pack, or for determining the number of sheets of material of any class within a single stack, the gage or caliper having indexed means which is readable direct to ascertain the number of sheets placed in the gage.

Heating and Lighting

GRATE BAR AND SUPPORT THEREFOR.—H. B. MCCONNELL, 34 S. 9th St., Newark, N. J The invention relates to grate bars which are readily interchangeable; an object is to provide a grate bar having high and low trunnions at both ends, and provide supports for the grate bar so that the latter may be supported upon either its high or low trunnions.

GAS BURNER.—R. R. CORNWELL and J H. MCCREADY, c/o Okmulgee Welding Works, Okmulgee, Okla. This invention more particularly relates to a gas burner for use in oil fields for firing the boilers with low pressure gas and maintaining proper steam pressure for drill work or the like. It is the purpose of the invention to provide a device which will operate effectively and continuously without clogging up or failing to operate.

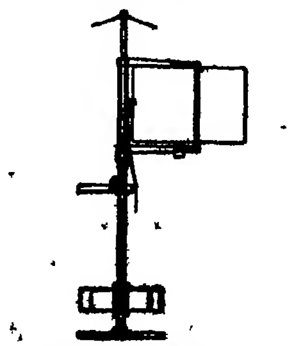
Machines and Mechanical Devices

MATTRESS BEATING AND SHAPING MACHINE.—W B. KNOPP, 1140 Hampshire St, San Francisco, Cal. The main object of this invention is to accomplish by power what is now done by hand Another object is to provide a power driven beater with means for changing the stroke so as to vary the force of the blow on the mattress in its process of forming and filling, and for turning and sliding the mattress under the beaters.

HYDRAULIC RAM.—J O. KAVANEK, Fort Bidwell, Cal. This invention is more particularly intended for installation in connection with subterranean water stratums at different levels. The general object is to provide a hydraulic ram adapted to be installed in a cased well extending between subterranean stratums that is the upper and lower levels of rise of the water in a well.

APPARATUS FOR BLEACHING, DYEING, ETC.—M. POSTERSON, Overlook Rd, Ridgewood, N J An object of the invention is to provide a construction wherein strings or strips of cloth are automatically changed and refolded in a more or less continuous action during the dyeing, bleaching or washing operation so that permanent creases will not be formed in the cloth, and the process will also be shortened.

WATER ELEVATING UNIT.—E. B. SCHUMAKER, Hilbert, Wis. The invention relates to a water elevator including a pump and a driving medium therefor Among the objects is to provide a wind motor which will function in the most variable and lightest of



A PARTLY SECTIONAL SIDE VIEW

breezes, which will elevate a great amount of water with a minimum amount of force, which will be equally adapted to drainage and irrigation work, and when once adjusted will be entirely automatic, requiring attention only when it is to be stopped.

(Continued on page [illegible])

A New Profession

(*Continued from page 207*)

The two best fields from which to draw illustrations of recreation engineering work already accomplished and planned ahead for that happy time when Congress may provide the wherewithal are the National Parks and the National Forest Service. In the parks it is called landscape engineering and the new department was opened in 1918. The director's reports show the manifold activities of the profession to include Vista cutting, clearing away trees that are down along roadsides general elimination of all dead trees, location of roads and bridges town planning forestry and the drawing or censorship of plans for all buildings to be constructed in any of the parks whether by the Government or by public operators of hotels and concessions. As much effort has been expended in advising what not to do as upon what to do

Items chosen from a long list of actual construction or recommendations for the future are quite assorted Various camp grounds were arranged for the numerous motor tourists and essential utilities provided Some present buildings not in keeping with mountain landscapes were altered as in the covering of an ugly post office with bark. In Yosemite the director spent half a year upon plans for extensive developments of the Park company, which are already under way according to this unified scheme He also planned the village of Yosemite allowing commercial industrial and residential zones In Mt. Rainier he approved plans for buildings in Paradise Valley An administrative group was designed for Longmire Springs In northern California a redwood forest proposed as a future park was inspected At Grand Cañon the relocation of some buildings and plans for an automobile camp and administrative group were made In Yellowstone new filling stations attractively made of stone and logs were put in sketches made for new ranger stations and alteration of some present buildings of public operators recommended At Rocky Mountain Park the site offered by the village of Estes Park for administration buildings was passed upon the structures considered and rustic gateways designed for roads entering the park Standard signs for all parks were designed of metal with plain green lettering upon a white ground and to be affixed to posts instead of to growing trees. Insignia to distinguish the various branches of the service will be worn

As the widespread use of automobiles and the motor tourist camp were a development not at first anticipated so the probable future use of airplanes is suggested Provision must be made ultimately for landing places signs and hangars to accommodate air travel. We may look forward to a time when funds will permit building a community center in each motor camp where tourists could gather under shelter for sociability or to hear lectures where they could rest read write buy supplies get mail use bathing and laundry facilities or study collections of the flora fauna and geology of the park visited

In the National Forests no special financial provision has been made strictly for recreation though advance work and plans have been started mostly by men engaged in other aspects of the forest work and with funds saved from other appropriations or provided by public-spirited citizens of the regions most accessible to the use of the improvements Thus in the national forests of California eight free leaseholds of sites have been given to communities from 25 to 150 miles distant three to Los Angeles and one each to Oakland, Sacramento, Fresno, San Diego and Riverside County Some of these municipalities have already built and paid for cabins and central cooking and administration and recreation buildings and arranged organized vacations for their citizens and taxpayers The business men of Sacramento are so pleased with theirs that they are raising a gift of $10 000 with which their city may build cabins In the eastern forests of the Seventh District including those in Arkansas Alabama Florida Oklahoma South Carolina Georgia North Carolina Tennessee Virginia West Virginia New Hampshire and Maine surveys of recreational possibilities have been made of the Pisgah in North Carolina the Wichita in Oklahoma and the White Mountains in New Hampshire and Maine Areas suitable for camps will be reserved and a start has been made in building fireplaces and sanitary conveniences at places most used by transients as in the White Mountains

Mr Arthur Carhart employed definitely as the first recreation engineer in the United States Forest Service concentrates his time upon the Second District comprising Colorado Wyoming Nebraska South Dakota Minnesota and Michigan In the San Isabel in southern Colorado 651 000 acres have been planned as a unit A number of utilities have been already put in in selected areas as shelters water supply sanitation fireplaces etc Two organizations of citizens of neighboring towns financed these In the Pike Forest of Colorado are attractive log shelters In the Shoshone of Wyoming Wapiti Camp is a splendid sample of what can be done for about $1000 A neat log hut, cement floored has three entirely separate compartments two bathrooms with running water modern plumbing and showers and a smaller alcove just holding a wood stove and water tank With free fuel at hand the tourist applies his match and cooks a meal while heating his bath water On the grounds are hydrants garbage pits fireplaces benches and tables Mr Carhart thinks the use of the forests of his district alone would justify the building of ten such stations a year for five years

This summer the planning of the glacier region of the Colorado National Forest will be undertaken and Mr Carhart has already spent some months in outlining the hoped for future of the canoeist's last frontier in the Superior National Forest in far northern Minnesota up to the Canadian border Within a million acres the timber is interrupted by 150 000 acres of lake surface which determines the character of the proposed development Without motor roads and railways water forms the avenues For easy pleasure a seven day motor boat trip is outlined taking in six lakes an Indian village several waterfalls and rock cliff paintings For the more hardy vacation seekers canoe trips of three seven and twenty days have been outlined and proper provision worked out for boat landings stores hotels camps at the end of each day's journey portage trails laid out places for pack and canoe rests indicated and signs designed to lead strangers safely through the wilderness Each sign would be visible ahead from the last one

Scattered all over our country are public lands awaiting funds for their fuller recreational development and dependent upon the creation of public sentiment that will teach the hands of taxpayers to find their purses Iowa to take an example has plans for a comprehensive system of state parks Its Conservation Commission has already secured several tracts and hopes ultimately to have a park accessible to any resident at a distance of not more than a county from his own home The American and Scenic Preservation Society an organization with head quarters in New York City has already done some valuable work in developing public areas for recreation uses

Philadelphia's Tear Bombs and Mobs

(*Continued from page 197*)

take the trail in motorcycles with side cars and overtake the fleeing motor car Shooting from a motorcycle going at a mile a minute is hazardous business at

RECENTLY PATENTED INVENTIONS

(Continued from page 208)

Machines and Mechanical Devices

CENTRIFUGAL PUMP—L. A Myers Box 5 Seabright City Cal. One of the foremost objects of the invention is to provide a self balancing runner for centrifugal pumps, the object being obtained by the use of a baffle plate for isolating the impeller disk from the reduced pressure at the pump inlet, thereby leaving the runner to float freely in the pump case and relieving end thrust thereon

SEWING MACHINE—A A Bolton c/o Jennings Lore Works Corp Park Ave and Hale St Brooklyn, N Y Among the objects of the invention is to provide a sewing machine in which the work is presented to the needle upon a traveling carriage in straight lines without any sidewise wabbling The invention has particular reference to the carriage construction and its associate parts.

WATER FEED FOR STEAM BOILERS—W A Whitmore, Nelsonville Ohio The prime object of the invention is to provide a receiver to which the feed water is delivered by a supply pipe and so associated with the trap that with each operation of the trap the water will flow to the boiler from both the trap drum and the receiver whereby any predetermined amount of water may be fed to the boiler with each operation of the trap

TIME CONTROL—J L Winkler, 28 Goss St Hempstead N Y The invention relates more particularly to a time control for use in connection with the operation of a photograph printing machine, although not necessarily limited to this adaption An object is the construction of a device which will automatically release the parts and extinguish the source of illumination upon a predetermined amount of time having elapsed

TURBINE—L. R. Guthrie Bellflower Mo An object of the invention is to provide a turbine embodying but relatively few parts which renders the device of simple and cheap construction A further object is to provide a turbine rotor having an arrangement of disks having concentric annular corrugations A still further object is to provide an automatic arrangement of governor for controlling the valves in accordance with the direction of the flow of steam

APPARATUS FOR RECORDING MOTION AND SOUND—R. D Gray, Midland Park N J The invention relates to apparatus for producing a moving picture film and a sound record in synchronism. The object is to provide an apparatus for recording motion and sound arranged to encompass a number of performers, say actors, players of musical instruments or other sound-producing media distributed on a stage or other support for producing both a kinetoscopic record and a sound record

REVERSIBLE FAN—R. M Murray Billings, Mont The purpose of the invention is to provide means controllable by the operator for changing the pitch of the blades, and for reversing the direction of such pitch By the aid of this device a fan or a propeller can be so manipulated as to produce an infinite number of variations in the volume of air, gas or liquid controlled so that the velocity and volume of the currents may be regulated without changing the speed or rotation

Medical Devices

FALSE TEETH ATTACHMENT—B Flisberg and W Sharp, address B Flisberg 1390 Clay Ave, Bronx, N Y The invention has particular reference to an attachment adapted to secure false teeth in the mouth of the wearer It comprises elements hinged to the opposite sides of the plate and means for normally effecting the movement of said elements to cause the same to grip the gums and to prevent the teeth falling when a person coughs or sneezes.

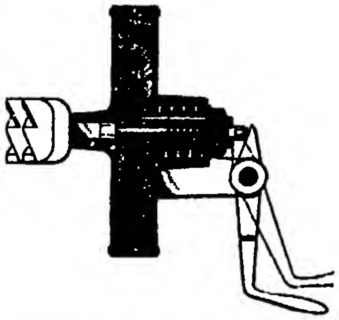
Musical Devices

TUNING SLIDE FOR TRUMPETS AND THE LIKE—F B Steindorff, Stillwater Minn The invention relates to an adjustable stop by which to determine the position of the slide to produce a note of desired pitch from the instrument The object is to provide a construction embodying threadedly engaged parts and stop members whose relative movement takes place without danger of impairment of the threads.

SOUND POST.—W E. Leighton, West Pembroke Maine. The invention relates to string instruments and more particularly to violins. The object is to provide a post which may be positioned directly under the bridge and by means of which the amplitude of the sound waves are given more carrying power together with a more resonant tone quality The post may be conveniently utilized in connection with different types of stringed instruments.

Prime Movers and Their Accessories

SAFETY CRANK.—C Green Cornwall Landing N Y The invention has for its object to provide a safety crank particularly adapted for use in turning an internal combustion engine over for starting the same, but



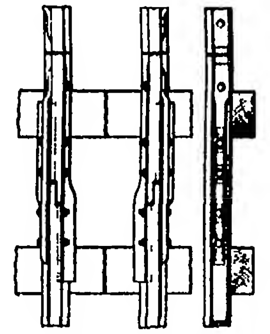
SECTIONAL SIDE VIEW OF THE INVENTION

which is not necessarily limited to this adaptation, and by means of which, upon a back fire occurring a retrograde movement will result through an arc of such smallness as to be well-nigh imperceptible so that no injury to the operator may result.

VULCANIZER.—W R Younger, Alexandria La This invention has for its object to provide a device of the character specified which may be attached to the exhaust pipe of an internal combustion engine as for instance that of a motor vehicle to support the vulcanizer in position for use and to heat the vulcanizer by the heat of the exhaust gases.

Railways and Their Accessories

RAIL JOINT — G J Murphy, Baradero F C C A Buenos Aires Argentina. The general object of the invention is to provide joint elements to insure the free expansion and



A PLAN AND SIDE VIEW OF THE JOINT

contraction of the rails under changes of temperature and the maintaining automatically of the joint bolts at right angles to the rails without straining the bolts, and to prevent jars or shocks as the car passes over the joint

DOOR OPERATING MECHANISM—J M Pombo, 58 W 91st St. New York N Y An object of the invention is to produce a power-operating door mechanism for railroad cars, coaches, street cars, and subway trains where it is essentially necessary to handle crowds and fill and empty coaches as fast as possible. Another object is to provide a door operating mechanism which may be operated by one man such as the motorman or engineer

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best If a hit is made it is mere accident. Then, too, the police take all the risk of collision Not long since a gang of youths too, the police take all the risk of collision Not long since a gang of youths was arrested in Philadelphia for automobile stealing and the leader, a seventeen-year-old, boasted of the tricks used by motor car thieves to escape the police He explained that a series of left-hand turns at forty miles an hour will invariably distance the fastest motorcycle if it is carrying a side car, as is usually the case Even without the side car, according to this expert, a motorcycle cannot turn with safety at as high speed as an automobile, so that escape is only a matter of continual turning

Some months ago a Trenton motorcycle policeman was shot and killed by a boy automobile thief fleeing from that city He had overtaken the car and rode alongside, or within a few lengths, for nearly a mile before he was struck with the fatal bullet. It is contended that had he been equipped with a tear bomb his life would have been saved, in all probability, as he had plenty of opportunity to throw it into the car Another advantage of the bomb for this kind of work is that it makes a stain on motor varnish by which the car may be recognized by police elsewhere, if the driver escapes his first pursuers

"These bombs will not be used against every crowd that creates trouble," says Superintendent Mills "They are for use only against mobs bent on destruction, mobs that assume dangerous proportions and that cannot be dispersed by ordinary methods. A bomb squad is being formed for each police division, and these men will be trained in the use of the new weapons. Only men who can keep their heads in emergencies will be appointed to these squads."

Copper-Fouling of Ordnance Materials

(Continued from page 197)

of sheets, bridges, tanks, piping, etc, are concerned

Without giving a detailed description I merely recall that the metal to be applied, that is to say, in the present case the tin lead alloy is introduced in the form of 1 mm to 2½ mm diameter wires in the central part of a blow pipe nozzle (oxyhydrogen or oxy acetylenic blow pipes) This thin wire is drawn longitudinally through the nozzle by means of a turbine actuated by compressed air When the blow-pipe is properly adjusted the melted metal is transformed, as it comes out of the nozzle, owing to the momentaneous depression that occurs at that very place, into comparatively low-temperature particles which are expelled with extreme violence by the blast of air

These particles stick to the surface to be covered, which can, in this manner, receive a thick or thin coating as desired In order that such coating may firmly adhere to the surface on which it is projected it is most indispensable that this surface should be properly cleaned by means of the sand blast.

The Schoop metal spraying pistol is recommended on account of its facility of working Its dimensions are 15 x 15 x 10 mm and it weighs 1½ kilos (a little over 3 lbs.), it enables projecting about 8 kg (16 lbs.) of tin lead alloy per hour Now, the quantity of metal required for each shell is very small as shown by the following table

75 mm	gun	6 to 8 gr
155 mm	gun	25 to 30 gr
320 mm	gun	80 to 100 gr

Therefore, shells can be coated in a very short time Besides, the coatings obtained in application of this Schoop process adhere most firmly to the surface and never detach themselves from the shells during their handling and transportation.

The brief statement given above illustrates the usefulness of this invention. "The use of this process," writes Colonel Mercier, Inspector General of the heavy Artillery material and training, "provided an immediate solution to a situation that became most serious. Moreover, it brought back to life guns of the largest calibers, that were considered as definitely out of use after 500 shots, while they have exceeded 1000 shots and still give an accurate firing." And in another note he again says "that as far as facility of adoption is concerned this process is not to be compared to any other since it is most reliable while being hardly noticeable"

A Problem in Levels

(Continued from page 198)

when it was found that the water level had been lowered only 8 inches. But this meant that the one skip was able to offset the inflow and do a little unwatering in addition The second skip was now installed, the work being done in 6 hours this time. By the following day the two skips had reduced the level about 2 feet. The pump room was now accessible from the air shaft, and the skips were kept at work intermittently until the pump could be started up again The skips were in fact, able to keep the water from rising again by being worked one-half or one-third of the time With a single skip at work a trip could be made in 75 seconds. But, by an effort, this time could be reduced, it was found, to 60 seconds. When two were working simultaneously, a skip would discharge every 31 to 38 seconds It took 20 seconds to hoist a skip and its load through 700 feet, and about 14 seconds were consumed in slowing down and dumping The dumping was done in 5 seconds. Mr Brackett calculates the capacity of the combination of two skips at 2120 gallons per minute The coal consumed in making steam for the hoisting engine is estimated at 19 gross tons per day of 24 hours. This estimate relates to the fuel properly charged against the hoisting of the water

The electrically operated hoists are now entering the field in competition with those operated by steam Local conditions naturally play a part here Where electricity is already used by a mine or group of mines, a hoist will likely prove most economical when made a part of the prevailing system Whether the control is better with electricity I cannot say If so, this would be a strong point, as loaded skips constitute more or less of a menace in vertical shafts Thirty-eight thousand pounds free to fall 700 or 800 feet might do some damage

Group Medicine

(Continued from page 201)

generally done for thirty or forty dollars There is hardly any question of exploitation of the patient here Well organized and self respecting Groups adhere as closely to ethical practice as though each man stood singly

Probably it is due to the influence of the Mayo Clinic at Rochester, Minn, that so many of the groups already organized are to be found in the West, and it is only recently that the more conservative East has become the center of the advance.

Clinics are now actively operating in Duluth, Minn, Minneapolis, Minn, La Crosse, Wis.; Madison, Wis., San Diego, Cal., Little Rock, Ark.; South Bend, Ind, Rockford, Ill, Cleveland, Ohio, Detroit, Mich., Lexington, Ky; Memphis, Tenn.; New York City, Rochester, N Y, Buffalo, N Y, and Syracuse, N Y There are undoubtedly others which are not so well known, but this list will serve to show how widespread the movement has become, and these clinics are only pioneers in a development which promises to supersede the old-fashioned form of medical practice. Group Medicine is one of the outgrowths of our complex life. The same spirit is abroad in other professions and we find the lawyers forming partnerships with regard to criminal and corporation law. The architect now affiliates with the

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constructional engineer, the heating and ventilating engineer, and the excavating engineer.

What more sane than that our bodies should receive the same consideration as our legal well-being or our habitations? The layman is the person most vitally affected by this new development for the *raison d'être* of medical science is, after all, the patient, and the medical profession keeping abreast of the times must work together in the future more closely than in the past for the ultimate relief of suffering humanity, emphasizing more and more preventive measures by the early detection of disease and thus securing our maintenance in health.

Sir James MacKenzie has recently organized a clinic at St. Andrews to be devoted to the study of the early symptoms of disease. He believes that "before organs begin to break down under stress of disease there is a period of infection or intoxication referable to the whole system but not definitely located. This is the *period of early signs and symptoms*. The symptoms are present but because they are not yet referable to any system or organ are largely discounted with the result that opportunities which can never recur are missed. Necessarily, the study of this vast and vague field demand tireless energy.

It is believed that eventually a medical examination of our bodies will be as much a routine of the year as is at present an examination of the teeth. Group Medicine is a step in the direction toward taking preventive measures in health as in sickness.

Fish Stories That Are Stranger Than Fiction

(Continued from page 202)

petrified article. A box full of them would pass for an assortment of whet stones just like those used by reapers in the fields for sharpening their scythes. One would never suppose that these stone-like objects could be converted into juicy fish-steaks. There are however, the tell tale flesh markings, and a few parings of a penknife from the boxwood-like substance tells you that you are in the presence of a delectable bonito-steak for which the Niponese in America pay two dollars a pound. It is used sparingly, however, by the Orientals, who grate it for use in soups and salads. An American business man would be apt to keep it on his desk as a paperweight and a constant source of mystery to his friends. Each bonito yields four such "steaks." They are sun dried without a particle of salt, then smoked thoroughly. The result is a stone-like product. It is perhaps the chief fish-product edible curio of the globe.

Another queer marine product from the inland-sea are dried clams. They are sold loose, or are spitted on split bamboo when fresh and thus dried. The so-called "bombal duk"—so much used by Orientals as a curry in rice dishes—is a regular Niponese product. It is rotted fish, "ripened" to the point where the cellular tissue breaks down through decomposition. Then it is sun-dried and put up in cans. The odor is disgustingly penetrating—so much so that one gets a whiff of it even through the supposedly impervious sheet-metal container. In use, the Asiatics take up a little of the light-brown substance and powder it between the fingers over their plates of cooked rice. It leaves a clinging, nauseous odor on the hands.

It is a singular commentary on the many faiths and creeds and notions prevailing amid the uneducated of Manhattan—and many of the educated, for that matter!—that a certain fish-product should be on daily sale here as a supposed cure for rheumatism. This is the eel-skin. It is sold in various sizes. The skin is tied around arm or elbow or wrist or ankle or thigh, or elsewhere near the affected part. And there are those who swear by its effectiveness!

Finally, the visitor may see on daily sale in the Mongul stores the hard shark's belly and shark fins. There are also canned rice-field worms (imported as rice "fish") Their nutritive value is low. And in the Latin quarters only—among the Iberian, Italian and French fish shops—one will find the fresh snails on sale in season alive, creeping all over the shop, while canned, stewed snails and frogs' legs, dried and fresh, are available. Seaweeds as food are obtainable regularly at Irish and Asiatic stores in large variety

The Granite Gorge Bridge Across the Colorado

(Continued from page 203)

Angel Trail. The packing of the cables down into the Canyon was accomplished on the 11th and 13th of April of the present year, and the two tasks were executed without a mishap. The journey in each case took from eight in the morning until four o'clock in the afternoon—two hours being allowed at midday for rest It should be borne in mind that the floor timbers, the hanger, and the stirrup rods had likewise to be transported on the backs of pack animals, and all told sometimes more than 40 tons of materials and supplies were thus got down to the river's edge.

The floor system of the bridge is suspended from the main cables by ⅝-inch special steel wire-rope hangers, placed 6 feet apart, which are attached to the floor beams by ⅝ inch steel stirrup rods, spaced at intervals of 8 feet Each hanger cable is yoked to two stirrup rods. The bridge floor is 5 feet wide with guard rails of heavy mesh wire, and owing to wind action and vibration it has been found advisable to provide impounding gates at each end of the structure so that only one mule or horse can be taken over at a time Until accustomed to the journey, the animals are blindfolded

The main cables were drawn across the Colorado and anchored during the second half of April, and before the month ended the floor boards were in position The suspension bridge was formally opened to travel on the 17th of May, and the span cost complete substantially $18 000 Two other bridges are contemplated for different points on the Colorado within the National Park area, and they are intended to facilitate still further rim-to-rim travel It is not hard to imagine the thrills that will be experienced by the uninitiated when first venturing across the bridge astride a blindfolded pack animal, even though the beast may be a sure-footed burro or mule.

Natural Designs Artificially Produced

(Continued from page 205)

formed. Others develop into fence-like or netted crystals, while others have certain axis parallel to each other

But each distinct substance which is crystalisable has a definite crystal shape, and this shape is seldom if ever duplicated in any other substance when examined microscopically This is due to the internal structure of the molecule, although there may be a few limiting forms possible with the same substance, such as the cube and the octahedron, etc But both are built of similar particles, and their arrangement, in the final analysis, is the same.

Three separate types of crystalised substances can easily be distinguished upon the slide of the microscope. These are the crystals themselves, the barred or crossed forms which have one axis parallel or nearly so, and those which develop curving or spiral-like shapes like winter flowers on the window pane.

Such forms can be produced from pure salts when dissolved in water and if a drop of this solution is then placed on a glass slide of the microscope. When the water has evaporated, which must not be hastened but progress slowly under ordinary atmospheric conditions, the characteristic shape which this substance will assume under these conditions will have been developed. Of course, some of the substances will here develop excessively in one direction at the expense of the others, but this is not true for all salts.

No matter how often the *same* substance may be taken and crystalised out of solution under *these* conditions, the *same* characteristic shapes will *always* be obtained. A drop of the substance is sufficient for microscopic analysis, and a very dilute solution is all that is necessary The most common solvent is water, and wherever possible it should be used. Alcohol and other very volatile liquids are not very well adapted for this purpose They seldom produce characteristic crystals since the rate of evaporation is much too rapid.

When a number of substances have been studied under the microscope, they will easily be identified with accuracy when seen again and an entire system for the identification of different salts can soon be developed by this method for those that are interested in this absorbing study

The growth of the different salts undergoing crystallization can be observed with greater ease and comfort than is possible when watching the development of ice flowers on the window pane. There is something fascinating in watching the sudden twists and turns of freezing waters, and one instinctively speculates on the direction of the next shoot But it is absolutely unnecessary to wait for winter to come along in order to see just as beautiful and artistic designs which Mother Nature produces during the night with the aid of a little moisture and cold.

Dyes for China

THERE is a big market for both indigo and aniline dyes in China, and, unfortunately, the quantities that are being sent are quite inadequate to meet the demand American and Continental manufacturers have got a big hold in China, and this is partly due to the British manufacturer's difficulty in getting export licenses Japanese firms are doing a big business in aniline dyes

In 1919, the imports of artificial indigo were valued at H K Tls 1.81 million, as against Tls.146,642 in the previous year, and those of aniline dyes at Tls.8 04 million, against Tls.752 000 in 1918. This shows a very striking recovery in the trade, but in spite of the great increase in price the figures are still much below the imports in 1913, when the value of aniline dyes and artificial indigo imported into China were Tls.5,401,820 and Tls.9,688,157 respectively

The consumption of synthetic indigo in China in 1913, the last normal pre-war year, amounted to about 17 000 tons. The much smaller consumption since that is accounted for partly by increased cultivation of natural indigo, and partly by greater economy in the use of the dyestuff

Against the pre-war price of about Tls. 40.00 per picul, synthetic indigo of the same strength is now selling at Tls.120.00 to Tls.140.00 per picul

Germany is gradually regaining a foothold with aniline and indigo dyes. Considerable quantities of German aniline dyes, supposed to consist principally of accumulated stocks, have arrived from Dutch ports, and are being eagerly bought up at big prices. Two German firms have their own German representatives in close touch with their old Chinese dealer associates, and one firm is reported to have booked orders to an extent of about Tls.200,000. The strong position held by German dyes in this market prior to the war still stands them in good stead, and as soon as sufficient stocks are available competition will be increasingly difficult. Unless our manufacturers succeed in introducing their own "chops" during the present shortage of German dyes they will have the utmost difficulty in getting a share of this important market.

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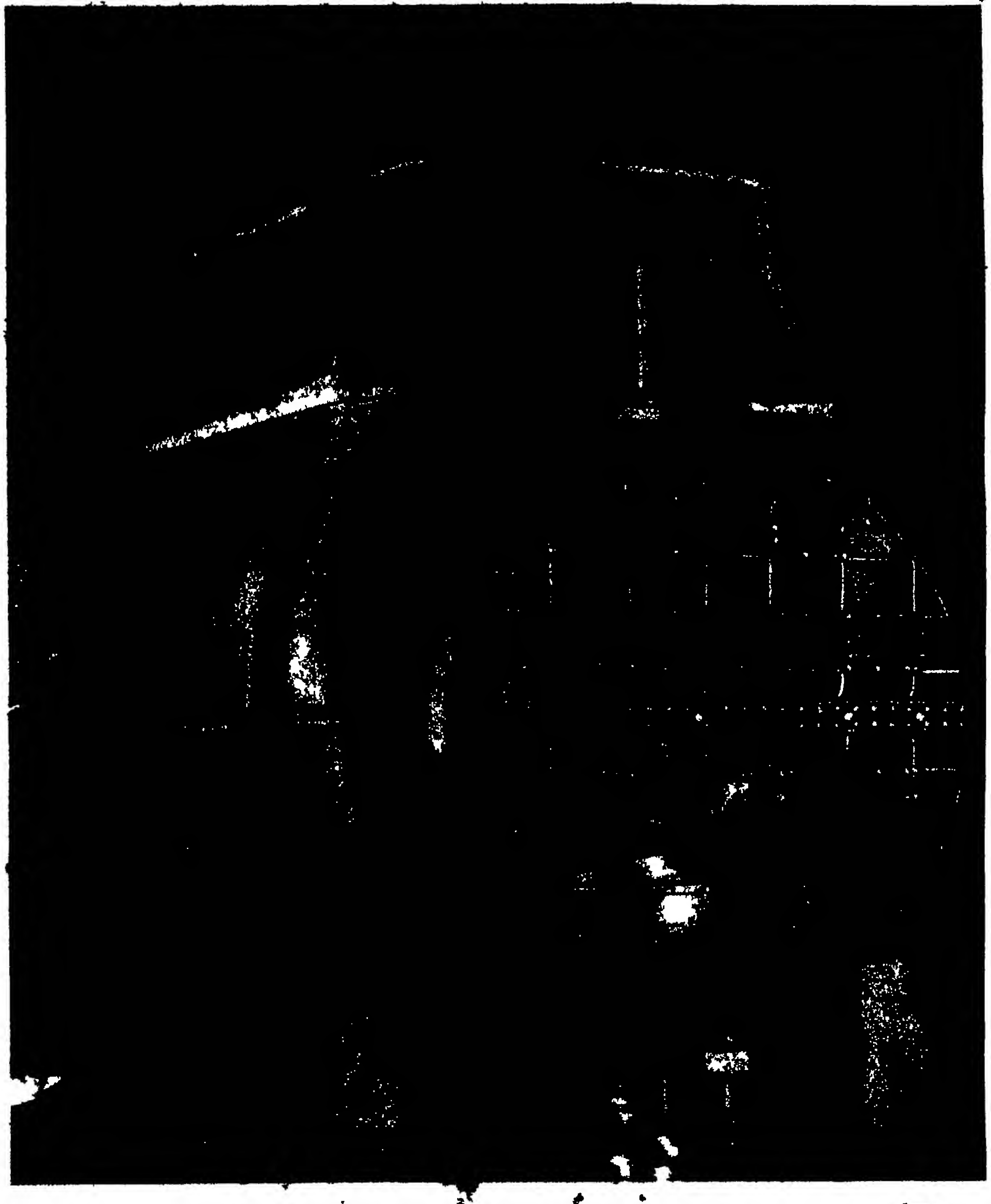

ASSEMBLING A HUGE CONDENSER UNIT FOR A STEAM-ELECTRIC POWER PLANT

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Is Airship Travel Profitable?

It has been proved that the airship if properly built and carefully navigated is a practical means of transportation When Zeppelin had brought his work through its purely experimental stages he built airships that proved to be reliable for passenger travel Statistics show that up to the outbreak of war, German airships carried over 35,000 passengers for a total distance of 100 000 miles without death or injury and many improvements including the mooring mast have been introduced since then Deplorable was the accident to ZR-2 but it will not prevent airship travel Deplorable also was the loss of the Titanic but people still travel in steamships and will continue to do so in increasing numbers

Airship travel is practicable is it also profitable? In the absence of any exact statement from the operating companies the question is open to conjecture with the probabilities in favor of an affirmative answer An analysis recently made by *The Engineer* is based upon a comparison of R-36 with the Cunard liner "Carmania," at the close of which our contemporary admits that the commercial prospects of the airship are 'hard to determine

'R 36 is a sister ship to R 34 which two years ago made a successful flight from England to the United States and back The Carmania is chosen in preference to a fast ship like the Mauretania because this type—on account of the high cost of operation and small freight carrying capacity we know to be uneconomical The Carmania carries 1905 passengers and a crew of 513 Making a round voyage in four weeks with full passenger lists she can carry 51 870 passengers per year 'R 36 carries 50 passengers and a crew of 28 At 65 miles an hour she would make the round voyage in seven days At full capacity she would carry 5200 passengers per year Hence ten similar airships could carry the same number of passengers as the Carmania The ten airships would include 15 700 horsepower and a crew of 280 the Carmania requires 21 000 horsepower and 513 men

This surprising economy of 25 per cent in power and 45 per cent in crew in favor of the airship is modified in the opinion of *The Engineer* by the probability that although with care the Carmania might run at full pressure *continuously* for a year the ten airships could not be so run—ten additional airships might be required as a reserve On the other hand upkeep is in favor of the airship, since only one out of the ten need be laid off at a time for repairs whereas the whole service must be withdrawn in the case of the steamship

On the question of engine up-keep the steamship shows to great advantage The power plant of the ten airships aggregating 400 cylinders 800 valves etc would have to be overhauled at the end of every second round trip, and the separate engine overhauls would amount to some 1300 per year Another expense peculiar to the airship would be the loss of hydrogen which at 5 per cent of the capacity per round trip calls for 55 million cubic feet replacement for the ten airships per year

Attention is drawn to the fact that there are features in the comparison, as given above, which clearly suggest the need for the utmost caution before a definite opinion is formed as to the commercial prospects of the airship The analysis neither proves nor disproves the case

On the other hand the economy of ground personnel, due to the use of mooring masts would place the airships at an advantage though against that must be set the much greater freight-carrying capacity of the Carmania' 'R 36' when fully loaded with 50 passengers, can take but 2¼ tons of baggage

Summing up our contemporary sees "the need for the utmost caution, before a definite opinion is formed as to the commercial prospects of the airship, and this in spite of the fact that in the important matter of capital costs the advantage inclines to the airship

This is an impartial study of a difficult problem, but we must not forget that airship navigation is yet in its infancy compared with that of the steamship, which celebrated its centenary nearly a quarter of a century ago

The Divining Rod

We know so well what comment will be offered on Mr Cone's article of page 219 that we take the opportunity of making it ourselves, in this place It is quite true that one of the most persistent of the medieval myths is that of the divining rod It is equally true that this myth is continually cropping up in modern times usually being invested with an ostensibly scientific character by being tied up with some phenomenon as radioactivity, which is at the moment imperfectly understood

On the other hand, nobody ever knows what the science of the future may bring forth It is by no means impossible that emanations of one sort or another are given off from every element and every compound not merely from the bodies so far officially recognized as radioactive It is by no means improbable that emanations of this sort, granted they exist are sufficiently different in point of speed intensity, etc for different bodies to make it possible to recognise the body from the emanations It is altogether likely that such emanations if they but exist, will penetrate matter quite as freely as X rays and the electrons etc to which we have attached the names of alpha beta and gamma rays An open minded attitude prevails on this subject in scientific circles, as attested by the fact that, in France the Academy of Sciences and the Ministry of Agriculture have been investigating the divining rod for some years while in Germany and Austria its possible military applications were tested under official auspices during the war

Heretofore the reports that have cropped up from time to time that such an instrument had at last been brought to the level of practical perfection have turned out to be wholly mythical and usually deliberate frauds in the bargain On general principles the probability is of course strong that any particular further case of similar claims is in a similar class It would seem plausible to suppose moreover that if the versatile divining rod which Mr Cone describes had really been invented in Germany and put into successful use in that country we should not have to depend upon the reports of a returned traveler for our information about it The tale implies discoveries of such import in physics that we should surely have expected it to have a conspicuous place in such journals as the *Physikalische Zeitschrift* and the *Annalen der Physik*

Mr Cone however is associate editor of a prominent technical and trade paper He assures us that he has investigated the story and he and his associates have sufficient confidence in it to give it a prominent place in their own columns Mr Holz is a dealer in scientific instruments of precision of the highest standing It is impossible to attribute fraud to him, and almost impossible to suppose that he is deceived in such complete measure as such a hypothesis would demand The impulse of the SCIENTIFIC AMERICAN toward this story was at first rejection, and later was toward suspension of judgment until we had been able to verify the details for ourselves. Unfortunately, however we have no oil well, no cache of hidden gold, in our back yard—no really effective means of trying the instrument on a deposit of mineral, whose location shall be unknown to the gentlemen who are promoting the fortunes of the divining rod So we have decided to cut the Gordian knot by letting Mr Cone tell Mr Holz's story in his own name and in Mr Holz's name We are inclined to credit the story but we are not in a position to guarantee it and do not see how we can attain such a position We wish to make it plain, however, that we carry the tale with full realization of its possibilities—both in the direction of fraud and in that of real achievement.

Scientific American Landmarks

At a time like this, when the SCIENTIFIC AMERICAN is about to make the radical change of appearing as a monthly magazine, we naturally feel reminiscent and turn to the time, over three-quarters of a century ago, when this journal made its initial and very modest appearance As started by its founder Rufus Porter, the whole paper consisted of only four pages, and as we recently noted in these columns the net printed edition was easily carried to the post office by one of its Editors

After some twelve months of rather precarious existence it was purchased by two young men, former schoolmates, Orson D Munn and Alfred Ely Beach Young Beach had been initiated into journalism in the editorial rooms of the New York *Sun*, and under the guidance of his father, Moses Y. Beach, the publisher and owner of that paper

The SCIENTIFIC AMERICAN started its career under auspicious circumstances. The railroad and the steamship were in the first flush of their commercial success. The spirit of invention was abroad, and America was upon the threshold of that career of industrial development which was to advance the young Republic to its present commanding position In the first half of the nineteenth century opportunities for acquiring technical knowledge were few for our present magnificent system of schools and colleges devoted to technology is of comparatively recent growth. Consequently, it was natural that the SCIENTIFIC AMERICAN, which was practically a pioneer in its field, should make an instant appeal and that its offices should become a place of rendezvous for the pioneers in invention and technical development Morse, Edison Howe of the sewing machine and many another whose name has since become a household term were frequent callers It was in our offices that Edison's experimental phonograph was first exhibited, when it startled the Editors by wishing them 'good morning' From the very first, the inventive and mechanical genius of America received a sympathetic welcome and much helpful advice in the editorial room of the young Editors and publishers

And what an era of invention particularly of American inventions that were destined to become world wide in use and reputation was the first ten years of the life of the SCIENTIFIC AMERICAN As we run through the record of that decade we come across Hoe with his development of the revolving press of Merriweather the California miner, with his hydraulic system of mining Corliss with his famous valve gear patented in 1840 Worthington with his independent single direct-action boiler steam pump The Jones and Sampson Machine Company with their turret lathes Elias Howe with his epoch making sewing machine followed by Wilson and Gibbs with their rotating hook, to say nothing of Singer from whose invention has sprung enormous business institutions still known by his name It was in this same decade that a Lynn shoemaker adapted the sewing machine to sew the uppers of shoes In the same period Otis installed his first elevator, and Charles Thurber patented a slow typewriter which embodied the longitudinal motion and Francis, four years later, improved it by introducing the piano hammer action Although McCormick had built his first harvester long before, the first practical harvester made its bow to the public at the same time as the SCIENTIFIC AMERICAN All of these inventions and a host of others of less significance were recorded in the paper side by side with the latest discoveries in science and the more notable feats in mechanical and civil engineering, scientific search and exploration, as well in the field as in the laboratory

The desire of the Editors to give a fuller presentation of the exhibits of the Centennial Exposition than was possible in a single paper led to the publication, in 1776, of the SUPPLEMENT, which became so popular that its publication was continued, under that name, for forty three years. In 1920 it was decided to change that publication from a weekly to a monthly The instant approval of this policy by the subscribers is one of the motives that has prompted the Editors and publishers to make a similar departure with the parent paper, and include the two separate publications in a single monthly, that will include the characteristic features of both.

Engineering

John Fritz Medal Award. — Eugene Schneider, French engineer and scientist, has received at Paris from the hands of distinguished American engineers the 1922 John Fritz medal Closer engineering co-operation between the two countries is thus promoted

A New Canadian Railroad. — It is announced that construction work will be commenced at an early date of a logging railroad northward from Squamish, British Columbia, to the vicinity of Lake Alice According to estimates upward of 2,000,000,000 feet of logs will become available for transportation by this means, and it is anticipated that something like the activity of former years will again be in evidence. The new undertaking will have incorporated with it the booming grounds formerly operated by the Howe Sound & Northern Railway, making possible the handling of unlimited shipments.

The Baku-Batum Pipe Line.—At the present time it is an established fact that pumping operations have commenced in the Baku Batum oil pipe-line on a small scale. It is reported that, at the present moment, there is in Batum only about 4,000,000 poods (about 500,000 barrels) of oil. This includes masout, kerosene, crude oil and gasoline, and covers not only oil which has come through the pipe line but also that which has been transported by rail. The pipe line is being used to pump masout. There is a small trade being done by a few Armenians and Jews who have been able to obtain oil in lots of 200, 300 and 500 tons.

Improvements in Palestine.—Assistant Trade Commissioner Julian E. Gillespie, who has just completed a visit to Egypt, Syria, Palestine, and Smyrna, states that the Government of Palestine has projected an enlargement of the ports of Jaffa and Haifa, the erection of a large waterpower plant sufficient to meet the needs of all Palestine, the irrigation of the Jordan Valley, and the construction of a railroad from the Sea of Galilee directly east to connect with the Bagdad Railway However, it is probable that only the port improvements at Jaffa will see accomplishments in the near future This project is being urged by the orange growers and shippers of Jaffa.

A Mexican Pipe Line is being planned by Clay T Yerby of Los Angeles, who has been granted a concession by the Mexican Government. The pipe line is to run from Puerto Mexico, on the Gulf coast, to Salina Cruz, on the shore of the Pacific. It is said that the pipe line will follow the Tehuantepec Railroad Work on the first pipe line, a ten-inch line, will begin at once and will be completed within 20 months. The estimated cost of the work will be 10,000,000 gold, and it is pointed out that by means of the pipe line the time of transporting oil from the east to the west coast of Mexico will be cut down by eleven days and the distance covered will be 2800 miles less than through the Panama Canal.

Electrification Projects in Czecho-Slovakia.—One of the newspapers of Prague reports that a plan has just been submitted to the Ministry of Public Works for the construction of a dam some 280 feet high at Stechovice, 22 miles to the south of Prague The proposed dam would be the means of obtaining 250,000 million kilowatt hours of electricity a year and of saving the Republic 60,000 carloads of coal. The first requirement for the proper development of this new Republic on an economic basis is said to be the increased national production, especially agricultural production To this end it is necessary to devise a plan for the best utilization of the hydraulic resources of the country and to study the means of putting this plan into operation. Many of the largest industrial organizations in Bohemia have already pronounced themselves in favor of the project, and its realization will be a big step in advance.

Amsterdam's New Grain Elevator.—The first complete and separate grain elevator, not a part of some other structure, in Amsterdam, has just begun operations. It is the result of dissatisfaction with the primitive methods which have always been used in Amsterdam for loading and unloading grain on and from steamships and railway cars. The elevator is located at one of the most important freight docks in the harbor, from which various railway tracks radiate It has a present capacity (which can be quickly doubled) of 132,000 pounds per hour, and is operated by electricity through a motor of 100 horsepower. Grain is put into sacks or loaded direct from cars to steamships, and vice versa, saving the cost of transfer lighters. Four weighing machines keep accurate account of quantities. The elevator building is constructed entirely of concrete, which has become a very much used material in this district for the construction of buildings and bridges and certain kinds of boats.

Science

"Oldest Dwelling" Discovered.—A stone-age dwelling, still containing domestic utensils, has been found, it is said to be the oldest so far discovered in Eastern Prussia.

Once in a Lifetime. — With the Lapland thermometers at 86 degrees, bathing parties are said to be popular among the sweltering Eskimos. The reindeer and other animals are suffering intensely

Child Suicides.—In the first half of 1920, 225 of our children killed themselves, in the first half of 1921 almost double that number committed suicide Fear of school examinations was the prevailing motive

Rats and Plague.—Observations on the eradication of plague by rat destruction strongly suggest this to be the main factor in bringing infection to a natural end Barium carbonate was found to be the best poison.

A Bolt from the Blue.—Without warning, rain or wind, lightning killed one boy and paralyzed two others near Nahant Beach, Mass., as they were walking home in their bathing suits.

A Busy Twenty Minutes. — In the next ten years astronomers have but 20 minutes in which to test Einstein's theory During the fleeting moments of the solar eclipses they will work strenuously in an attempt to discover any deflection in the rays of light that pass the sun.

Edibles from the Amazon.—The Mulford Biological expedition is already accomplishing good work in the Amazon basin, and has made one important shipment of botanical specimens, among them three edible fruits, the pepino, the tumbo and the acchocta, and a turnip-like root, rhacache, of delicious flavor

Metric Bill Before Congress. — The Britten bill would make it unlawful, after ten years, to sell charge, or collect on other than a metric basis Manufacturers opposed this propaganda so strongly that they secured their exemption under the present bill, but its passage would doubtless be the opening wedge for a general adoption of metric weights and measures.

Paper from the Bamboo.—Before long, according to British scientists, the manufacture of paper from bamboo is likely to be undertaken on a large scale in several countries. Well-equipped factories are already running in Indo-China and others are being planned to handle the supply from Trinidad, Burma and Madras. Paper made wholly of bamboo pulp is said to be well suited for the higher grades of printing paper

New Test for Gold.—The Bureau of Standards has perfected a spectroscopic analysis of gold Tiny electric sparks jumping from one stick of gold to another are photographed through a diffraction grating, the most minute quantities of the baser metals are revealed, and the highest grade of the San Francisco mint, known as "1000 fine gold," is shown to be but 99.997 pure The findings of the device are said to be accurate to one part in a million

Thumb-Sucking As a Beauty Spoiler.—An American writer in the *British Journal of Photography* reminds us that Sarony, the New York photographer, attributes the cause of one side of the face usually being less well formed than the other to the child's habit of sucking the thumb, which permanently distorts the cartilages of the nose. Sarony, who was well known to the present abstractor, always maintained that one side of the face was better than the other and usually proved his case

French Colonial Exhibition. — After 16 years of planning by the cream of French talent, a magnificent park of 90 acres' extent is nearing completion at Marseilles. Here will be held the Colonial Exhibition and here, grouped around a spacious esplanade, may be seen striking reproductions of Algerian palaces and Asiatic temples, housing the products of the colonies, modern halls will hold the machinery and finished goods exported to the foreign possessions. Four congresses will study colonial questions of health, production, tools and organization, while other meetings will discuss science, art and literature

Fox Talbot Memorial.—W H Fox Talbot, inventor of the calotype (talbotype) process, and the first to produce positives from negatives, died in 1877 His large historical collection has recently been presented to the museum of the Royal Photographic Society, and includes a camera lucida, a sketching camera, and scientific instruments used in his experimental work These, with the notable Hurter and Driffield collection and other apparatus of national interest, are features of the Society's annual exhibition, opened to the public on September 19th. The Society is calling for popular contributions to a fund to be used in setting up a permanent memorial at Lacock, the birthplace of the scientist.

Aeronautics

A French Air Port.—Official figures for the movement at the air port of Le Bourget near Paris, during the month of July, show that 511 airplanes, carrying 2285 passengers, 13 tons, 7 cwt of goods, and close upon four tons of mails, entered and left the "port." Last year's figures for the same month were 390 airplanes, 965 passengers, and 9 tons, 3 cwt of goods.

Britain's Secret Helicopter — Press announcements recently have directed our attention to the new type of machine which is being constructed at the Royal Aircraft Works at Farnsborough, England It is reported that only the most trusted workers are being employed in this work, and that the tests are to be conducted at an isolated spot and most likely at dusk, so as to preclude spies Much is expected of the new machine, and it does seem as if the British have hit upon a new idea in flying machines.

Civil Air Services in French Guiana.—At present six hydro-airplanes are running a regular service between Saint Laurent du Maroni and Cayenne and Paramaribo (Dutch Guiana), and air transport has become popular both for passengers and freight. Transportation of goods is very remunerative, as people prefer to send gold, balata, essence of rose, etc, by aircraft, which cover the distance from Saint Laurent to Cayenne in six hours, whereas by canoe the time taken is twenty days.

Aviation at Foochow. — Several successful test flights have been made with a hydro-airplane constructed by Chinese engineers at the Chinese Government Dock and Engineering Works at Foochow All the material used in this plane (which was specially designed by a Chinese engineer), with the exception of the engine, which is of American design and manufacture, was produced in China The Foochow works have several more of this type of airplane under construction for use by the Chinese navy

An Airplane Flight to the North Pole is to be attempted by Edwin Naulty, an American aviator, according to recent press announcement This aviator proposes to start from Point Barrow, in Alaska and hopes to reach the northwestern corner of Spitzbergen The airplane will carry four men and fuel for a fifty-hour flight. If conditions permit, several landings will be made on the polar ice, but if this proves impossible the 1800-mile flight will be made without descent. From Spitzbergen Mr Naulty proposed to continue his flight via Norway to London The flight may throw some light on the doubtful existence of land in the eastern part of the Beaufort Sea

Daily Service to Capital.—A New York organization has just announced the purchase of six Fokker limousine monoplanes to be put in immediate operation between New York City and Washington, D C Each plane will carry six passengers and 1000 pounds of baggage on a trip It was our recent good fortune to witness the flight of a Fokker monoplane over the Hudson River from lower New York City Frankly, this machine is far more graceful than the usual biplane It flies with a remarkable steadiness and at a surprising speed Then, too, judging from its economical operation there is every reason to believe that this type will be used more and more for passenger-carrying purposes

Government Control of Aviation.—From Washington comes word that investigation into the probable scope of Government regulation of commercial aviation, under proposed legislation, has been begun by the Department of Commerce According to Secretary Hoover, Government supervision of air traffic along the lines of rail and water regulation was recommended by a committee of the War Navy and other Departments, in order to increase the safety and more efficient development of the new method of transportation It is not unlikely that a bureau of aviation will be created, charged with the enforcement of rules of air travel similarly to the activities of the Bureau of Navigation in connection with water carriers

Multi-Engined Geared Power Plant.—Realizing that the future of the passenger-carrying airplane depends very largely upon the development of reliable and powerful engines, Edson F Gallaudet, an aeronautical designer and builder of East Greenwich, has constructed a power unit for large airplanes consisting of three Liberty engines geared to a propeller with a clutch This power unit is claimed to assure non-stop flights from New York to Liverpool in 20 hours or less. Two Liberty engines are side by side, with one in back, it being the plan of operation to run two engines with one always in reserve. Each Liberty engine of the group develops 400 horsepower The Gallaudet power unit, along with two others of the same design, is to be delivered to the U S Navy

Saving Food Fish by the Hundred Million

How Victims of the Mississippi Overflow Are Returned to the Main Channel

By George H. Dacy

Launch and rowboat are used to carry the rescued fish back to the open channel, where they are released

JUST as regularly as the calendar completes its annual cycle the Mississippi River goes on its spring jamborees and rampages overflowing its banks inundating bottom lands which verge its boundaries for several miles inland and washing untold myriads of adult and baby food fish far away from their natural habitat the open channel—marooning these finny river residents in temporary ponds pools and puddles where ultimately they die unless rescued by man and returned to the river. Some years back the Government fish authorities sensing the vast economic importance of fostering foundation schools of river food fish carefully scrutinized the Mississippi uprising devastations to the extent that they finally instituted a system of organized fish rescue work which from that time to this has been effective in saving approximately $77,000,000 worth of breeding fish for the replenishment of our Father of Waters and its tributaries and for the stocking of inland lakes and streams.

The Mississippi River floods which are serious limiting factors in spelling the success or failure of the cotton crops abutting its borders in Mississippi, Louisiana and Texas are even more grave menaces to the multiple fish tribes which populate its waters. The most destructive Mississippi freshet—from the fish protection standpoint is known as the June rise and occurs just about the time the adult fish are ready to spawn. It develops considerably later than the spring freshets caused by melting snow but is equal to them in volume and accomplishes more serious damage. When the river rises and overflows its banks it carries vast volumes of water to inshore depressions nooks and crannies which for the time being—after the recession of the main part of the flood water—are converted into miniature ponds pools and lakes some of which are many acres in size. Obeying their natural impulses to seek places of quiet and seclusion the adult fish desert the main channel at flood time and seek the backwater regions where they deposit their eggs.

The eggs are laid under propitious circumstances and environments which result in the hatching of large crops of young that from the outset develop rapidly and often attain lengths of several inches before the freshet begins to subside. The adult fish immediately make for the open channel when they appreciate that the flood water is receding and attain places of permanent safety before barriers in the form of stretches of land suddenly released from flood captivity shut off their retreat. The young fish do not react promptly to the ebbing freshet and soon are landlocked in the temporary puddles and pools. Some of these overflow pools dry up in a few days or weeks others endure for several months constantly diminishing in size due to seepage and evaporation while others remain until late fall when they freeze up. The larger pools provide rich feeding grounds for the baby fish where they grow as large as 8 or 10 inches in exceptional cases before ice forms. However in any event the landlocked fish ultimately die of starvation—unless rescued by human agency—smothering when the ice forms in small pools or succumbing to cannibalism or being destroyed by wading birds snakes turtles and other fish eating creatures.

Uncle Sam's rescue parties usually consist of 5 to 8 fish experts to a crew usually recruited for the campaign from among the employees of the Bureau of Fisheries. They ply the innundated areas in gasoline launches and house boats and utilize flat bottom row boats for penetration to the points where the water is extremely shallow. Armed with fine-mesh seines small dip nets, galvanized iron wash tubs of one and one half bushels capacity and tin dippers they invade the temporary ponds and lakes and capture the run away fish. The rescue season usually begins about the first week in July and continues until after Thanksgiving when the ice forms over many of the waters so densely that further salvage work of this description is impossible. The stretch of the Mississippi covered by these fish conservation activities extends from Minnesota to Mississippi, although during the fiscal year ending July 1, 1921, the work was concentrated largely in Minnesota, Wisconsin, Illinois and Iowa as in this region the damage is greatest and salvage most important. A dozen crews operating out from special river headquarters in the territory mentioned saved 120,000,000 fish worth approximately $6,000,000 from landlocked water fates last year. This salvage amount is an average representation of the fish rescue work. Several years ago a record rescue of 157,000,000 food fish was consummated. Fish experts estimate that at least 25 per cent of the fish rescued ultimately attain a marketable size at about the age of one-and-one-half years and are consumed as human food.

Practically all the varieties of food fish native in the Mississippi are saved by the rescue crews, such breeds and families as the crappies carp catfish, buffalo fish sunfish pikes perches and black bass being most common. The fish are caught in seines, and when lifted they are rapidly transferred to the galvanized tubs which contain supplies of river water. The fish catch is computed by the displacement of water in the tubs which is carefully measured the fish being sorted as to variety. As soon as possible the rescued fish are conveyed in rowboats or launches to the open waters where they are again liberated in the Mississippi. Approximately 1 per cent of the rescued fish is sent to special retaining stations where they are trained and hardened so that they can stand long railroad shipment. Finally they are shipped in milk cans or carloads to various lakes and inland streams where they are used for stocking such waters. The cost of this salvage work is insignificant the usual rescue expenses amounting to not over 25 cents per thousand fish saved while during recent years annual costs as low as 13 cents a thousand fish have been recorded.

It is necessary to agitate the water in the tubs where the fish are kept during their trip from the inland pool to the river as otherwise, many of the tiny swimmers would be smothered. This is accomplished by elevating dippers of the water several feet above the tubs and then allowing their contents to pour into the receptacles. This combined with the squirmings about of the masses of juvenile fish keep the water well aerated. Extreme care has to be exercised in handling the fish, especially those taken from the shallow pools from which much of the overflow water has abated or evaporated, as the [illegible] and vitality of such specimens [illegible] low because they have suffered from lack of food while they were landlocked [illegible] [illegible]

The small fish are sorted as to size, variety and sex as they are [illegible]

Silk Purses and Sow's Ears

YOUR grandmother's favorite exemplification of the utterly and absurdly impossible was to the effect that "You can't make a silk purse out of a sow's ear. From your grandmother's viewpoint there was simply nothing to debate about this—it was the acme of self-evident things. But a prominent firm of chemical engineers, in connection with the recent chemical show in New York, have undertaken to show that you can't always tell what is impossible.

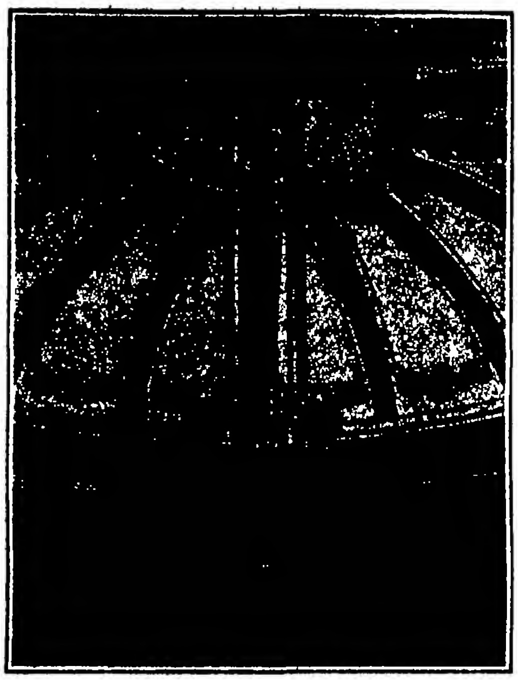
The silk-worm produces silk by forcing a gummy mass through tiny orifices in its head, the jets hardening into silk fiber as they reach the air. Almost anything in the nature of a gummy mass ought to be susceptible, artificially, of the same treatment. So they got from one of the big Chicago packers a mass of sticky stuff that was guaranteed to be pure extract of sow's ear, and they treated it just as one would treat cellulose in the silk factory—that is to say, in the artificial silk factory. The result was a perfectly good variety of artificial silk, and when there was enough of it it was woven into a silk purse for the show

So it is demonstrated that in the light of science the assertions of a thousand generations may need reconsideration, and nothing should be considered offhand as impossible.

This purse of (artificial) silk is made from glue guaranteed to have originated in a sow's ear

The Biggest Lighting Fixture

WHAT is declared to be the largest indirect lighting fixture ever built has just been installed in a new theater in Milwaukee, Wis. It has a diameter of 15 feet and weighs approximately 5500 pounds. The large bowl is so immense that it was necessary to provide a second bowl to illuminate it. The top bowl contains 118 lamps and can be reached by means of a ladder extending down the 25 feet from the hole in the center of the dome. To support this fixture eight 2-inch pipes 25 feet in length are required From the smaller bowl a cable can be lowered, it has at the end a leather outfit. This enables a man to be hoisted to the small bowl so that he can clean the lower surface of the large bowl.

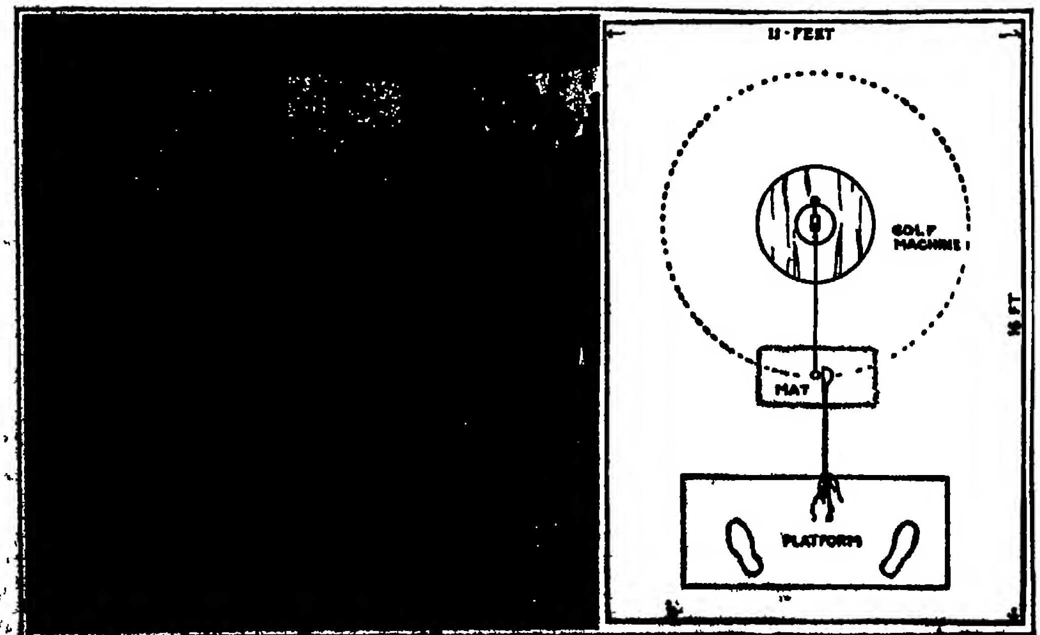


A lighting fixture 15 feet across

A Golf Machine

WHO has not heard the lament of the duffer, who can "swing in perfect form" on a grass-blade or a cigarette box, but who the moment a little white pill is substituted for this unresponsive target, develops a slice or a pull that is horrible to behold? Here we have the cure for this state of affairs—a little instrument that will do away with grass-blades and cigarette boxes as targets, and supply in their stead an object to swing at which will flatly contradict the duffer's cheerful belief that the blind swing was flawless. For the truth must be that if a ball were to be miraculously dropped in the path of one of these "perfect" swings, it would be found to show the same old slice or pull or topping.

The machine illustrated is nothing more or less than a captive ball hitched to a dynamometer But instead of the ball being on an absurdly short tether, so that in the very nature of the case nothing can be recorded save the mere force of the initial impulse given it, this ball is wired to a near-frictionless collar that rides on a vertical shaft. The ball, struck by the club head, takes flight to the limit of its tether, and then instead of bringing up dead it proceeds to spin round and round, carrying the collar with it. In a general way it stays in the air as long as it would if it were free, and [illegible] the moment the ball begins to pull out of the true line the resultant drag upon one edge of the collar is communicated to the dial, which ultimately registers the distance which the sphere would have made down the course. Each revolution of the captive ball amounts to ten yards of actual flight and is so recorded. For its setting up the outfit requires a space sixteen feet by eleven, it has to date found especial popularity on board steamship A photograph of the device appears below, as well as a diagram of the layout in actual use and space required



The latest and most effective machine for indoor golf, and how it is set up

Device Shows Students Dissection Work

IN one of the large lecture rooms of a prominent French university in Paris there has been installed an improved apparatus that projects dissection work vividly on a screen The frog, rat, guinea pig or whatever animal is made the subject of the lecture is fastened on the table where the demonstrator can handle it readily Suspended above the table is an object glass which is surmounted by a large reflecting prism that throws on the screen a clear picture of every movement in the operation This presents all the details to the students and greatly enhances the value of the lecture, permitting them to see just what is being done or illustrated The lighting system is the unique feature of the apparatus. For this purpose three great anti-aircraft searchlights are used They are each of 5,000 candlepower and cast a brilliant light on the subject of the experiment or demonstration. It has been found through tests that these lights radiate far less heat and give a more satisfactory light than the electric arcs that are commonly used in this connection.

The Costliest Remedy in the World, Otherwise Known As Radium

THIS seems to be the era of Unknown Energy Psychologists have found forces, hitherto unsuspected in man, and physicists are intently alert on radio-activity and its sources

Radium, at first regarded as a mere curiosity to illustrate a lecture on physics, could be bought for $2 a milligram, as there was no demand for it now the same quantity would fetch $30 to $40, as America no longer gets any from Austria, and that obtained from carnotite is extracted at great expense and the yield is small The same difficulty of expense exists when it is used in the form of a gas inhalation or bath

The question of these emanations is one of serious study in Germany, England and America But, to carry out the whole thing technically, national institutes should have a well-equipped physical laboratory, an industrial one to work on the raw products, a biological section and also a therapeutic one Waters and natural gases must also be studied, though the radio-activity may often prove very weak Careful records should be printed in and distributed from all national institutes, giving the natural and local sources of radio-activity in minerals, waters and gases, with a view to the increase of knowledge concerning its procurability and therapeutic uses.

Its healing power has given it such a high value, and Madame Curie, at the Spanish Health Congress in Madrid this year, spoke hopefully of the present modes of treatment

In certain cases weak injections of insoluble radium salts can be given and for this, both in France and Germany, thorium X, a side product of radium, is used It does not accumulate in the system and, in high dosage, produces considerable physiological effects.

As the emanation of radium is soluble in water, radioactive water can be used as a drink or as a bath The water quickly loses its power when exposed to open air, so it is a little difficult to determine the quantity used

All through the war Madame Curie went on working in her laboratory and for the soldiers. In 1911 she was accorded the Nobel Prize, and this year has received the highest honors from her own University of Warsaw We all know of Madame Curie's recent visit to the United States, where she received the gift of one gram of radium and was showered with the highest honors.

Keeping the Railroads Afloat

The Water That Our Steam Lines Use in a Year and What They Do With It

By Charles Frederick Carter

IF the deductive method of reasoning which made Sherlock Holmes famous were applied to their annual consumption of water as the sole clue in order to form an idea of what railroads were like, the conclusion would seem to be justified that they must be navigable streams. The quantity of water required to keep *the railroads of the United States afloat* is beyond the conception of the average man.

According to C. R. Knowles, Superintendent of Water Service of the Illinois Central Railroad, recognized as the foremost authority on the subject, the estimated annual consumption of water by the railroads is 900,000,000,000 gallons. As a considerable proportion of the water used by railroads, amounting to 23 per cent in some instances, is purchased from municipal or private water corporations and hence is metered, and as a number of the larger companies have water service departments which keep careful records, this estimate is more than a mere guess.

Perhaps it may help in attempting to form an idea of the immensity of this volume of water if it be reduced to cubic feet and the quotient divided by 1,080,000, the flow in cubic feet per second of the Amazon. The result shows that the railroads consume a quantity of water equivalent to the total flow of the greatest river in the world for a period of 32 hours and 48 minutes. Or, to apply a standard of comparison nearer home, the volume of water used by the railroads is equivalent to the total flow of the Mississippi River at its mouth for 58 hours, or 2 days, 10 hours, 47 minutes.

Twenty million cubic feet of water tumbles over the crest of Niagara Falls each minute. If the annual water consumption of the railroads were diverted into the Niagara River it would run the cataract for 101 hours, the equivalent of 4 days, 5 hours, 8 minutes.

Collected into one body the railroad water supply would make a lake ten miles square and 44 feet deep. Bottled and sold at current prices for so-called "Spring" water affected in large cities, the proceeds of this railroad deluge would bring in $90,000,000,000, or enough to pay off the entire interest-bearing National debt with the proceeds of less than seven weeks' average sales.

Locomotives consume for steaming purposes, or waste, 74 per cent of the total quantity or 2,807,999,965 tons of water. The total quantity of freight hauled by the railroads in 1916 was 2,316,068,894 tons, that is, the quantity of water passing through locomotive tanks and boilers was 491,911,091 tons more than the entire amount of freight moved in 1916.

Of the remainder of water required for railroad purposes 12 per cent is required to wash boilers and fill them at terminals, 5.5 per cent is consumed by stationary power plants at shops and terminals and 8.5 per cent is required for sanitary and "domestic" purposes at stations, offices and terminals and on board trains. At 7 cents per thousand gallons the cost of the railroads' annual water supply amounts to $63,000,000.

The matter of water supply is by no means the least of the perplexing problems confronting the railroads. For twenty years the increase in consumption has averaged 1.5 per cent a year. At that rate the consumption in 1930 will be 1,085,000,000,000 gallons. Already the limit of available supply at reasonable cost at some points has been reached.

Many of the Western roads have extreme difficulty in procuring sufficient water to keep the traffic moving. Between Bitter Creek and Green River, Wyoming, on the Union Pacific, local water supplies are so bad that they cannot be used for any purpose. Every drop used has to be hauled in tank cars from Green River. Rock Springs, 15 miles east of Green River, supplies the entire Union Pacific system with coal. The water there is so bad that the company is obliged to pump a supply through an 8-inch main for the fifteen miles, including a lift of 179 feet. At Rawlins, east of the Continental Divide, the company pumps its water supply for 15 miles, the lift in this instance being 236 feet.

Near the western shore of Great Salt Lake a Southern Pacific water tank is supplied by a pipe line 52 miles long. Altogether there are 150 miles of pipe line between Ogden and the Sierras to supply water for Southern Pacific locomotives.

Locomotives are supplied at approximately 13,000 water stations in the United States. Until very recently the standard type of water station, a familiar sight to every passenger who took the trouble to look out of the windows, resembled an exaggerated butter firkin on stilts. Usually they were 16 feet high and 24 feet in diameter, their bottoms being 16 feet above the rail. Such a tank held 50,000 gallons. As locomotive tanks increased in capacity to 10,000 to 12,000 gallons and traffic grew in volume such a station became altogether inadequate.

Modern practice is exemplified on the Rock Island, which has a number of steel standpipes of a capacity of 165,000 gallons, from which 12-inch supply lines lead to 10-inch water columns, and on the Santa Fe which also has steel standpipes 24 to 60 feet high with capacities of 96,000 to 202,000 gallons. The Chicago and Alton has some tanks 18 feet high, 30 feet in diameter, 20 feet above the rail with a capacity of 90,000 gallons from which 14-inch mains lead to 12-inch water columns through which 4000 gallons a minute can be delivered. The Pittsburgh and Lake Erie has steel tanks of 150,000 to 500,000 gallons' capacity, their bottoms 21 feet above the rail, with 12-inch mains leading to 10-inch water columns, capable of delivering 2000 gallons a minute.

Even such facilities as these are wholly inadequate to keep the traffic moving on the great trunk lines. On these lines all fast trains are watered from track tanks without stopping. On the New York Central between New York and Buffalo are 14 track tanks, and 10 more between the latter place and Chicago. From each of these tanks from 500,000 to 1,000,000 gallons of water are delivered into locomotive tanks daily.

The usual track tank is pressed out of a single piece of sheet steel from 3/16 to ¼ inch thick, stiffened with a half round or bar of steel riveted to each upper edge, and supported directly on the ties. The width varies from 19 to 20 inches, the former being the prevailing size. On the New York Central the standard length is 1400 feet, on the Pennsylvania 1500 feet. The depth is strictly limited by the necessity of keeping their tops below the tops of the rails because of the scant clearance of brake rigging, and the impracticability of dapping ties to a depth of more than 2¼ inches. This restricts the depth to 6 to 7½ inches.

To take water from so shallow a trough requires accurate adjustments. The scoop should not scrape the bottom of the trough and it must dip at least 2 inches in the water. The height of tender and scoop may vary an inch between light and loaded weight; the wear of scoop pins and bearings and of tender springs and wheels may cause another variation of ⅝ inch, while tests have demonstrated that the pressure of the water against the scoop when running 40 to 60 miles an hour will pull the tender down an inch. Therefore it is necessary to allow for a variation of not less than 2 inches. These tanks are kept filled through several inlets by automatic valves actuated by the change in water level in the trough. Three minutes is the average time allowed for filling a track pan. In winter the pans are heated to prevent freezing by a steam pipe discharging directly into the pan at intervals of 33 feet. The surging due to scooping and filling distributes the heat sufficiently. A boiler of 100-horsepower is required to heat two track pans and furnish power to pump water into them.

While, as already noted, the railroads in numerous instances have incurred great expense to secure a water supply from a distance this would be altogether impossible in all cases. Usually it is absolutely necessary to use whatever local supply is available. Much of the boiler feed water contains salts of lime and magnesium which form a scale on the tubes and boiler surface. Often various other foreign matter is contained. Water in the coal regions contains liberal quantities of sulfide of iron which, when oxidized, forms free sulfuric acid. There are instances on record of such water corroding tubes, fireboxes and boilers so rapidly as to threaten to put busy railroads out of business. This trouble is now obviated by treating the water with soda ash.

Generally speaking, water in eastern territory contains very little foreign matter and boiler tubes will last 15 or 20 years with little attention. In the Middle West the water is hard, while west of the Missouri River and in the Southwest it is hard and also contains alkali which causes a great deal of trouble by foaming. Foaming can usually be controlled by blowing off, but at excessive cost for fuel. Iron Mountain, Neb., is said to be the worst place in the United States, for the boiler water there contains an average of 253 grains of encrusting solids to the gallon. In addition to the encrusting solids raw water from the rivers of the Middle West, often used for locomotives, carry from 5 to 6 pounds of suspended matter, i.e., plain mud, per thousand gallons, which means that a locomotive takes into its boiler from 100 to 120 pounds of mud on a trip.

Five years ago the American Railway Engineering Association estimated that every pound of encrusting matter kept from entering the locomotive boiler meant a saving of 7 cents, taking into account only the cost of fuel, repairs and renewals of flues and boilers and loss of engine time, but not including cost of engine failures which were estimated at $17 each.

The enormous increase in the cost of fuel and labor for boiler repairs since then has given a great impetus to the work of installing water treating plants. It is estimated that there are now 600 railroad water treating plants at which 21,600,000,000 gallons of water are treated annually. This is only 6 per cent of the treatment needed.

As a practical example of what can be accomplished, the Missouri Pacific treated 1,363,305,000 gallons of boiler feed water in 1918, removing 3,599,473 pounds of scale forming material, thereby effecting a saving of $279,848.

Engineering Bulletin No. 3 issued by the U. S. Fuel Administration estimates that the use of hard water in locomotive boilers involves the consumption of 15,000,000 tons of coal more than would be required if the water were softened by proper treatment.

In many ways there has been a marked improvement in the handling of the railroad water supply. Formerly the Superintendent of Bridges and Buildings exercised a sort of casual oversight of water supply. Wherever possible a windmill pumped the water, provided the windmill wasn't broken down. Elsewhere an uneconomic steam plant, often in incompetent hands, did the pumping at extravagant cost.

In recent years a good many electric pumping plants have been installed entirely controlled by floats connected with a switch. One such plant on a Western road has been installed in duplicate so that there may be no failure of supply in case of breakdown. The plant has a capacity of 1,000,000 gallons a day. The old steam plant required a force of 3 men; the electric needs but one man. The current costs no more than fuel for the former plant, so the net saving amounts to $1500 a year. Oil engines of the semi-Diesel type are being extensively installed, a single manufacturer having sold 495 such engines of 9627 aggregate horsepower to railroads in 5 years.

Another saving is being effected by stopping the waste of water which is very great, for the daily consumption average 2,500,000,000 gallons, delivered through innumerable connections under the control of thousands of employees who have no conception of the value of water. There is no such thing as an insignificant waste of water. For example, a 1/16-inch stream, such as may escape through a worn faucet washer will, at 40 pounds' pressure, waste 13,844 gallons a month which at 20 cents a thousand gallons amount to [illegible], enough to buy a new faucet. The Illinois Central, by a continuous campaign against waste of water, has effected a net saving estimated at [illegible] in five years.

WE are quite accustomed to statistics setting before us the vast tonnage of coal used up by our railroads in the course of a year, and to being told how much of this is burned up in hauling more coal for the carriers to operate their regular freight and passenger service with. That coal alone will not make a locomotive go is quite as obvious as the fact that an automobile will not run on gasoline alone, without the proper amount of air and oil and water. But when we hear the truth about the water consumption of America's railroads, the figures are sufficiently startling to justify the length to which Mr. Carter goes in writing about them.—THE EDITOR.

The Divining Rod Made Respectable

Modern Mineral Location That Proceeds Along the Lines of Medieval Magic

By E. F. Cone

AN invention which bids fair to revolutionize mineral prospecting has been announced. Some of the developments are positively startling. In December of last year Mr Herman A. Holz of New York gave the preliminary details of a new German invention which was described as the old divining rod rendered efficient for the detection of minerals, metals and even crude oil. Mr. Holz, a dealer of the highest standing in scientific instruments of precision, stated that wonderful progress had been made in Europe in the last four or five years, in the utilization of atomic forces, that processes and practical means had been developed to a high state of perfection for definitely locating solid, liquid and gaseous deposits in the earth without boring or prospecting, and even for accurately determining the position, depth, width and thickness of each deposit and for differentiating between the various materials forming the deposit.

The invention has been developed by a German engineer of high standing, who for many years was chief engineer of a prominent boring and drilling company. Mr. Holz personally visited Germany a year ago to investigate and study the invention and the tests to which it had been subjected. He himself located with the apparatus an extensive lead-zinc-silver field in Germany and thoroughly checked all phases of the device.

The principle on which the new instrument is designed is described by Mr Holz as follows. All materials of mineral origin seem to give off certain emanations, different for each element. The difference probably lies in the speed of the electrons given off, and has some certain relation to the atomic weight of the elements. These variations, carefully studied by the inventor, permit him to differentiate clearly between the various materials forming a deposit, by synchronization of the apparatus to the waves of different form. Thus, if the apparatus is adjusted for lead, it is actuated only by lead; if set for oil, it is acted upon only by oil. The apparatus can be adjusted for practically all useful materials found in the earth, such as all ores, salts, coal, sulfur, asbestos, oil, natural gas, etc. There are several very remarkable features of this process—remarkable, of course, only because so very little is known about the atomic forces utilized.

First of all, the emanations or rays penetrate everything except pure metallic lead. This proves their similarity to X rays and the radiations given off by radium.

Second, the emanations are given off by the materials at definite, carefully determined, different angles. These known angles are utilized in the practical applications of the process for determining the depth and exact location of the deposit.

Third, some of the rays are perceptible at a distance of 50 miles from the deposit, indicating its presence and general direction from such a distance, thus adding greatly to the practical value of the process in field work.

Fourth, there is no personal element entering into the use of the apparatus, it works equally well and correctly with everybody and repeats its indications exactly at the same spots, thus proving in the most reliable manner the presence of certain forces in definite directions. Mr Holz says:

"The strength of the atomic forces which act on the apparatus is often surprisingly large. We seem to possess not the slightest idea of the magnitude of some of the forces which are present on earth and which have not yet been explored in this country. I feel certain that systematic research work along these lines would clear up some of the great mysteries with which we are still confronted—the mysteries of electricity, of magnetism, of life. I have reasons to believe that the divining rod, used for over a thousand years and in some cases undoubtedly with success, is acted upon by a few of the rays which are utilized completely and systematically in the highly developed apparatus."

Since the announcement of this remarkable invention, developments have been rapid and startling. Through the efforts of Mr Holz and his acquaintance with the inventor as well as because of his standing among scientific men, arrangements were made with influential interests in New York for the coming to this country of the inventor for the purpose of thoroughly demonstrating and testing his apparatus. Accordingly early this year the inventor Philip Scherumly, of Frankfurt am Main, Germany, arrived in the United States and, under the direction of one or two skilled mining engineers set about his work of proving the claims made for his new device or practical divining rod.

The first test was made among the iron ore fields of the Lake Superior region. Here, through ice and snow several feet thick, the 'polarizator,' as the new invention is called, located new ore fields said to be worth many thousands of dollars, according to the reports of the engineers. The next trial was in the Pittsburgh district where new pockets of natural gas were looked for. There also, it is reported the explorations were 100 per cent satisfactory. The last trial was in the oil fields of the southern part of the country. There also it is claimed a 100 per cent record was made in the location of new oil pockets or fields.

The definite result of these trials was the incorporation of a new company to use exclusively in the United States the new instrument, and the payment to the inventor of a large sum for the concession. John Hays Hammond, the well known American engineer, is one of the most interested men in this movement. The new company is stated not to be a commercial proposition but will be engaged in research and geological studies.

The large economic value of this invention is self-evident, if the expectations of its promoters are realized, it will revolutionize mining methods and reduce the speculative phase of prospecting to a minimum. It should be added that in the operation of this new invention, cartridges of the material sought are placed in the device, the mechanism then synchronizes the emanations, exchange reciprocally, and locates the definite confines of the material in the earth.

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Where the Fish Go

To the Editor of the SCIENTIFIC AMERICAN

I note in your issue of April 2nd a letter by Mr J. M. T. Hamilton saying that the greatest destroyer of fish next to themselves is the waterfowl. He also condemns the pelican as the worst destroyer and estimates their number at one million. I should like to quote from an article in *American Review of Reviews* for May, 1919, an account of a trip made at the instance of the Federal Food Administration by Mr T Gilbert Pearson, Secretary (now President) of the National Association of Audubon Societies, for the purpose of ascertaining how many brown pelicans were living along the coast, and the character of their food.

"Here is what we found as to numbers. Of the seventeen islands on the Texas coast said to contain colonies of pelicans, we were able to visit all but one. A group was found breeding on only one of these, and here we found eighteen eggs and thirty-two young. We credited Texas with 5000 birds and went elsewhere. Every foot of the Louisiana coast was cruised and the colonies all visited. We recorded 50,000 for that state. It is the writer's opinion that in June, 1918, the brown pelican population along that 1400-mile strip of coast from Mexico to Key West did not exceed 65,000 adult birds.

"Regarding the food of the pelican at this time (the nesting season), Dr Hugh M. Smith, Chief of the U. S. Fish Commission, reported that in every specimen sent him that was collected between Rockford, Texas, and Tampa, Fla., was the Gulf menhaden, a fish never used for human consumption. Neither the writer (Mr. Pearson) nor the State's representatives with him could find one single food fish. Of the 3428 specimens taken in Florida waters only twenty-seven individual fish were of a kind ever sold in the markets for food, and not a single specimen of the highly prized varieties, such as trout, mackerel, or pompano, could be discovered in possession of any pelican.

"The Federal Food Administration has felt constrained to say that the charge against the brown pelican has been disproven."

Dongan Hills, S. I., N Y. C DEWAR SIMONS, III

To the Editor of the SCIENTIFIC AMERICAN

Your issue for April 2, 1921, contains an article signed J M T Hamilton on the subject "Where Some of the Fish Go."

The man who wrote this evidently is unscientific in his observations and inclined to accept loose statements of others and pass them on over his signature as facts. He reports someone as estimating the number of brown pelicans in the South as exceeding one million, and that "each consume a hundred fish a day, making a total of one hundred million destroyed by this one variety of sea-fowl," etc. His inference is that the pelican is extremely destructive to valuable fish.

You will, I think, be interested in the following statement. In the summer of 1919 at the request of the United States Food Commission I visited every known breeding colony of brown pelicans along the gulf coast of the United States. The states of Florida, Louisiana and Texas cooperated by supplying vessels, crews and provisions for the expedition. The undertaking was for the purpose of determining as nearly as possible the number of brown pelicans frequenting our Gulf Coast and also see if they were as destructive to food fishes as was popularly reported.

Every possible precaution was taken to learn the real facts. In each case a State representative was with me visiting the islands and checking up the data. Without going into detail I may state that we found about 65,000 brown pelicans from the mouth of the Rio Grande to Key West and this was after allowing liberally for non-breeding birds that were not frequenting the nesting colonies.

Large quantities of fish disgorged in our presence by pelicans both young and old were forwarded in tanks given us for the purpose, to Dr Hugh M Smith head of the Bureau of Fisheries in Washington for identification. Our investigation and Dr Smith's report revealed the fact that very few food fish are consumed by brown pelicans at this season of the year. From the Mexican border to Tampa Bay, Florida, absolutely every one of the thousands of fish disgorged in our presence were Gulf menhaden, a fish never used for human consumption. From Tampa Bay to Key West of the three thousand, seven hundred and twenty-one (3721) fish collected *only twenty-seven were food fishes*. These consisted of mullet, pig-fish, pin fish and crevalle, all low grade fishes. Any of them sell for 4 cents a pound in the local market.

I need only add that after receiving this report the United States Food Administration refused to take any action looking to the destruction of the brown pelican. While my observations were made entirely in the summer, the United States Department of Agriculture at once took up the work with a view of gathering data throughout the year. While their report has not been made I have been informed privately by those having the matter in charge that the amount of food fishes destroyed by pelicans at all seasons of the year is extremely small when one considers the charges made against the bird.

I am sending you this in the interest of fair play for one of our most interesting birds of our Southern waters. T GILBERT PEARSON.

New York, N Y

Nothing New

To the Editor of the SCIENTIFIC AMERICAN

It may be worth while to review another anticipation.

Before the recent war you published a short correspondence letter I sent you recommending oppositely revolving parts to cancel gyroscopic interferences.

The all metal Rohrback monoplane used by the Staaken airplane factory appears to be built in this way 'symmetrical,' but why did not some person make use of this published suggestion during the war?

Necessity may be the mother of invention, but this does not prove war is a necessity.

Earleigh Heights, Md. J FRANK GELLETLY

Another Job for Sawdust

To the Editor of the SCIENTIFIC AMERICAN

With reference to your article of April 2nd, "Jobs for Sawdust," no doubt there are many of your readers that would be glad to know that about 2 inches of sawdust spread over a very dusty country road will make the road dustless. This has been tried and found to be very satisfactory. In very dry weather the road will have a layer of very fine dust sometimes three or four inches deep. The sawdust will keep it down.

W A HOEVEMAN

A Bridge Building Record

How Cities, Officials and an Industrial Works Pooled Interests, Cut Red Tape and Met an Emergency

By E. W. Davidson

After the early morning fire of June 17th, showing the remains of bridge

TO build a wooden bridge 400 feet long and 83 feet wide in ten days for $35,000 faced with such an order what would the ordinary or the extraordinary bridge constructor do? Gasp? Smile patronizingly?

It can be done. It was done. With a great burnt gap in the important link of lines bridge between them, Lynn and Revere, Massachusetts, stood on opposite sides of the Saugus River during the early part of July and saw it happen.

The actual time of construction was ten days. Counting in the clearing away of burnt parts before reconstruction could begin the whole job took exactly 18 days one hour and twenty minutes. A bare 31 days elapsed between the burning of the old bridge—with firemen hampered by a failure of the bridge standpipes to function—and the throwing back of the gates on July 18 to permit a glad parade of automobiles across the new structure. Traffic on the main highway to the north shore of the Saugus was thus resumed in a minimum of time.

The train of events leading up to this remarkable undertaking started with the fire on June 17th partly destroying the original structure across the Saugus River. That fire broke a vital traffic artery. On the following day the Metropolitan District Commission announced that a new bridge would cost between $60,000 and $150,000 and no funds were available. But in view of the fact that a $50,000 state emergency fund existed the Commission's engineers started specifications anyway. On the 21st Lynn, Revere and the town of Swampscott asked the Commission for a temporary bridge. A hearing was announced on the 23rd and held on the 30th. In the interim the Commission's engineer had reported that to build a bridge costing $150,000 would mean shutting off travel for six months.

By July 12th all burned piles had been replaced or spliced and each bent capped

This suggestion of delay with the summer's heavy automobile travel just starting worried Lynn and Revere not a little. But on the 29th the day before the Commission's hearing the big electric company with works near the Lynn end of the bridge offered to rebuild the bridge in temporary form at cost within 15 days. Engineers scoffed but H. S. Baldwin, department engineer of the General Electric, was sure it could be done. That afternoon Mr. Baldwin went out in a rowboat and inspected the ruins. That night complete tentative plans and cost estimates were made.

The next day after the hearing the Commission decided to let the electric company go ahead. The city of Lynn appropriated $40,000 to finance the work and Governor Cox gave assurance that the state would reimburse the city next winter when the Legislature meets.

Detail plans were drawn July 2, the engineers finishing them in the small hours of the next morning so that they could be given to contractors for bids. The contract was let at $14,200 and the electric company agreed to furnish the materials and supervision for $20,000.

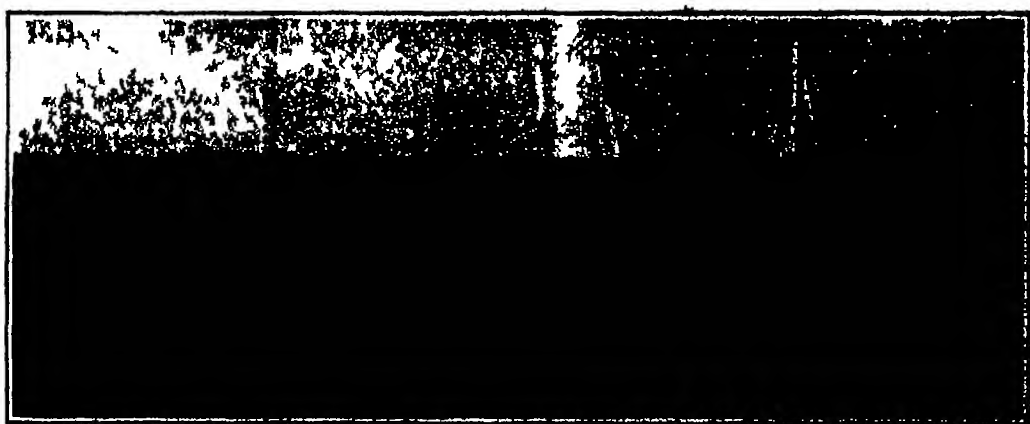
On the morning of July 4 steam derricks appeared at the bridge and work started tearing off the damaged deck and weakened piles. Three days later new construction began.

Storms and heart-breaking obstacles interfered from the start. At first it looked like a month's job. Flood lights were put up and the work drove ahead night and day. As days passed the outlook grew brighter.

By July 12 all the caps except on six spliced joints at the Lynn end of the bridge were in position. On the 14th it was possible to cross the bridge on the loose planking while the cross bracing went ahead swiftly.

When the job of laying the wearing surface of 2 inch spruce planks began the workmen were sure that sawing would take ten days to two weeks. An individually motor-driven circular saw table with adjusting arrangements operated by two experts was rushed out from the Lynn Works. The planks were cut at the proper angle as fast as they could be fed. The laying of the planks was so swift that Mayor Creamer was able to drive the last spike on the 18th and the bridge was done.

Only the best materials have been put into the structure. The new piles are of oak, the stringers, caps, deck, fence post and hand rails are of long leaf hard pine and the wearing surface of spruce. 270,000 board feet of lumber have been used and thousands of bolts, made upon order at the General Electric plant, thereby saving time and money, will hold the whole together for years to come. The caps are 8 x 14 inches and the stringers 10 x 16, spanning joints. Instead of a temporary bridge, it is made as well as if not better than the original structure and is guaranteed for ten years. Its substantial character may be noted in the lower view.

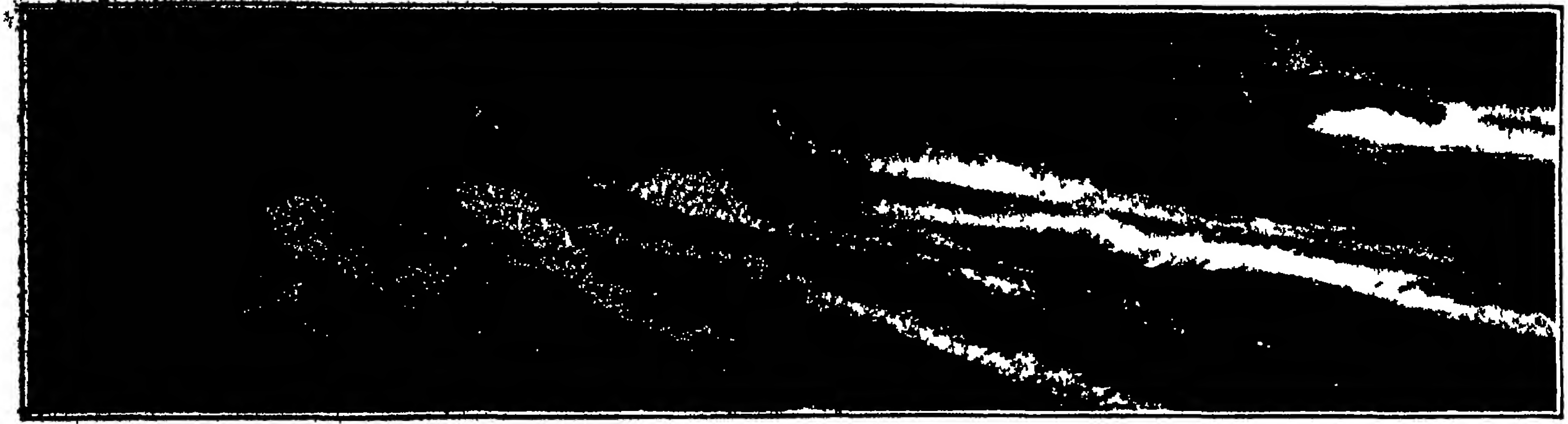


The completed bridge on July 18th, ten days after actual work began

Getting a Line on Concrete Pipe

LABORATORY investigations involve the making of test rings of pipe 6 inches long and of the desired diameter. They correspond to sections of the pipe as built in factories. The making of rings for testing purposes necessitated the designing of a special machine capable of not only regulating the pressure exerted by tamping but in measuring its intensity. Such is possible by extending the core 2½ feet above the outer form which acts as a guide for the tamper. The latter, a cast-iron shell 7 inches high with handles permitting its elevation, is allowed to drop by gravity on the materials between the forms a certain number of strokes so as to apply the proper test.

The testing machine employed in breaking the rings is described as a rubber bag which fits inside the rings, the open ends being bulkheaded. Water is forced into the bag slowly until the enclosed air makes a get-away, after which pressure is applied gradually until the specimen subjected to the test breaks. The apparatus is said to yield satisfactory results, uniformity being obtained to a surprising degree. The achievement is accredited in a major degree to the fact that the water pressure within the bag and against the bulkheads keeps the latter free from the shell of the ring. Here is a notable illustration of the strength of concrete pipe, testifying to the value of choice materials. Six-inch rings, 28 days after being manufactured, withstood an internal pressure of [illegible] pounds to the square inch or an equivalent tensile strength in the shell of over [illegible] pounds per square inch. The specimens were [illegible] graded and [illegible] [illegible]



Start of the Bearcat class of runabouts

Harmsworth Cup Remains in America

THE International Motor Boat Race for 1921 brought two boats to the line that were remarkable for the enormous horsepower of the engines which had been crowded into their frail hulls. One of these "Miss America II," an enlarged edition of 'Miss America I,' was a typical "Gar" Wood craft, a hydroplane with a single step, built of wood and of extremely light construction. Her motive power consists of four modified Liberty engines with a maximum power, each, of 450 horsepower, the total horsepower available being thus about 1800. 'Maple Leaf VII, unlike her predecessors, which were displacement craft is a single-step hydroplane equipped with four engines of even greater horsepower than those of "Miss America II the total being given as between 1800 and 2000

The race was held on Labor Day September 5th in the Detroit River, distance 40 nautical miles. 'Maple Leaf VII' was first across the line, but as they came around on the first lap 'Miss America I had taken the lead with Miss America II twelve seconds behind "Maple Leaf VII' was third and Miss Chicago fourth 'Maple Leaf VII sprung a leak and had to withdraw, sinking shortly afterward

The race was won by 'Miss America II which covered the course of forty nautical miles at a rate of speed which on the fourth lap slightly exceeded 71 miles per hour

In the race for the Lake George trophy for the one-mile speed-boat championship of North America, Garfield A. Wood's boat won again. The course consisted of six runs over a measured mile, three with and three against the stream. The fastest mile with the current was done in 44 18 seconds and the fastest against it in 45 05 seconds, the average being just under 80¾ miles an hour; nearly equal to the fastest railroad speed

Bacteria Being Killed by Magnetic Fields

CURIOUS effects have been incidentally observed by a well-known Swiss engineer, Mr. R. K. Müller, of Zurich, while treating rheumatic and nervous complaints by the application of magnetic fields, changing direction about 100 times per second. In fact, any infectious diseases his patients happened to be affected with would undergo a most beneficial influence, severe colds disappearing in a surprisingly short time—sometimes in a day or so. When this state of affairs became known, some families of mountaineers from the Engadine would every year in the fall come down to Zurich to undergo a treatment at Müller's laboratory, after which they [illegible] influenza. Some remarkable cures of tuberculosis having likewise been involuntarily effected, Müller undertook some experiments with a view directly to examining these striking phenomena

The apparatus used in this connection was the same as used for therapeutic purposes, viz., a coil of wire traversed by a relatively strong alternating current (30-40 amperes, 120 volts, 100 periods per second) and comprising in its interior a specially designed iron core. A chemist specialized in the physiology of fermentation helped with these experiments, which were made in a laboratory where the conditions of temperature and light could be well checked and kept practically constant

Fermentation bacteria were found to be arrested in their development by the action of magnetic radiation whereas experiments on luminous bacteria gave rather unexpected results their growth being either checked or promoted by the magnetic field according to the way the apparatus was arranged. The most remarkable result, however was that the feeding medium containing the bacteria would under the action of the alternating magnetic field become immunized against any further infection

Some striking series of tests on luminous bacteria have been recorded on plates. One illustrates the variable blackening of the photographic plate by the light of bacteria exposed either outside of any magnetic field, or in a stationary magnetic field as produced by a steel magnet, or in an alternating field, as produced by the coil of wire above referred to

Three 'gratings cut out of double tin foil were in a light tight box, placed on a photographic plate three glass bulbs containing the feeding gelatine with luminous bacteria (pseudo-lucifera) being applied to these 'gratings. By stirring the glass bulbs the feeding gelatine was distributed uniformly and made to cling to the glass walls. The outer surfaces of the glass bulbs were ground level thus enabling the bacteria cultures to be observed in the microscope

After 24 hours action of the bacteria the plate between the cuttings was found to be blackened the interesting fact being incidentally noted that the light of the bacteria had passed through the double layer of tin foil. The effect was least marked in grating I (not exposed to any magnetic field) somewhat stronger in grating II (exposed to the south pole of a steel magnet) and most intense in grating III (exposed to an alternating field)

Another plate shows two glass bulbs of the size of a watch, containing luminous bacteria and exposed to no magnetic field and to the field of the south pole of a strong steel magnet respectively the bactericidal effect in this case being very striking

These experiments would seem to confirm the fact brought out by common experience at Mr Müller's laboratory that organs infected by bacteria are made more resistant by a magnetic treatment

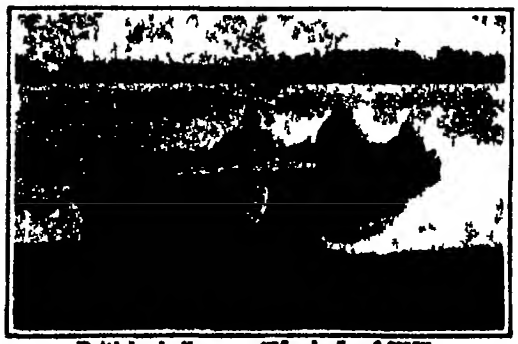
A New Telescope

A SWISS inventor named Rosing is reported to have constructed a light electric cell for telescopic purposes which responds to variations of light much more rapidly than any selenium cell thus far invented and which possesses the great advantage of not being subject to fatigue

This cell which is already in use for practical purposes in Rosing's telescope consists of a hollow ball filled with rarefied hydrogen or helium. Upon one side it is covered with sodium amalgam or potassium amalgam while upon the opposite side it is provided with a platinum electrode. When the amalgam surface receives a negative electric charge and is afterward illuminated an immediate discharge takes place the electric current connecting the two electrodes can pass from the platinum electrode to the amalgam. Hence as a result of the illumination it is able to overcome the resistance with which it was formerly unable to cope.

According to the experiments made by Rhigi and Stroletow the strength of the photoelectric current which is here operative corresponds precisely to the intensity of the light. Indeed it follows the variations of intensity in the illumination so exactly that the most peculiar effects can be obtained for example by the use of an intermittent light. The inventor calls this instrument an elektroskop. This new apparatus is now being tested by Marconi in his wireless telephony experiments

"The four 450-horsepower engines of "Maple Leaf VII"



British challenger, "Maple Leaf VII"

Successful defender, "Miss America II"; horsepower, 18[illegible]

Glass Tubes by Machine

How Handwork Has Been Eliminated from a Task Formerly Done Altogether by Hand

MACHINERY is nowadays being applied to all kinds of service There is, in fact, scarcely a broad line of activity into which mechanical methods have not gone Some have been more conservative than others, and amongst these one may perhaps list the business of manufacturing glass articles. In recent years, however, even this field has been invaded, and now it appears as if machine processes were about to carry everything before them

One of the particular lines of glass manufacture that is even now in process of yielding to the general spirit of the times is that which concerns itself with the production of glass tubing The writer was recently in a large works in southern New Jersey where three machines were already installed and another was just about being put in—machines whose business it is to produce glass tubes by an automatic procedure No hand is required to touch the glass from the great tank furnace where a great body of molten glass is produced up to the point where tubes five or six feet long are rolled down onto a pile. No hand takes the glass from the furnace, no hand conveys it to the great blow pipe, no hand forms it on the end of this blow-pipe, no hand pulls it off and draws the new tubing along, and no hand severs into short lengths the tubing as it perpetually comes on. The machine, or rather plant, is very automatic indeed

Glass tubing is wanted for a number of purposes. Thus, it is largely used as stock from which vials are manufactured Then, it is used for making up various articles used in chemical laboratories. Cut up into short lengths, it supplies the blanks from which the steam-gages used on boilers are made. The fact that a manufacturer produces tubing does not necessarily mean that he sells it all He may use it himself in making up many articles. However, it is desirable to produce the tubing accurately in such diameters and such wall thicknesses as may be specified Naturally, these dimensions can not be controlled with anything like the precision possible in manufacturing, say, cold drawn steel tubing. At the same time, a good deal of accuracy is required This is particularly the case where steam-gage tubes are to be produced for railroad companies. The outside diameter may be required to be not more than 1/32-inch greater or smaller than specified The factories have found it difficult to meet requirements as severe as this, and consequently there has been a large amount of waste. This is particularly so where hand methods of tube drawing are depended upon. It is perhaps too early to say whether the machine will readily meet the difficulty in the end. After some rather close attention to the matter, the writer thinks that the machine process should lend itself more easily to accuracy than the hand method.

The advantages of the machine, however, are perhaps rather to be found along other lines. Perhaps the chief of these centers in the *continuity* of the new procedure. The glass tubing comes on all the time. It is perpetually cut off at the end, but it still comes on. This is quite a contrast to what occurs in the old method

In order to get a good, clear idea of the machine process, it will be well to have before us a brief statement of the old-time way of doing things. Imagine, then, a big circular furnace with eight or ten openings, and a pot of molten glass corresponding to every other one A man gets on the end of his blow pipe a gob of the material It may be necessary, later, to get additional glass by introducing the blow-pipe and the gob already on it. The gob is roughly molded by manipulating it on a half mold kept cool by water The man blows into the blow-pipe and creates a central hollow in the gob. The glass is manipulated on a flat slab called a marver for the purpose of giving it a conical side surface. It is desirable to manage things so that the cavity will have the glass equally disposed about it. When the amount of glass is big enough, the cavity deep enough, and the disposal of material round it perfect enough, blow-pipe and gob are carried to the vicinity of the walk or runway where the tube is to be drawn. A small furnace, called a "glory hole," is set up near by Here the gob is reheated preparatory to the drawing Two men handle this work, the more skillful one retaining possession of the blow-pipe The other man secures a hold on the gob by means of an instrument called a punty This is a rod with a disk at one end, the disk having the rod perpendicular to it at the center The man holds the rod as if it were a handle, the clear face of the disk having previously been made to cling against the surface of the gob It is quite important that the punty disk be affixed just right in order to retain its hold.

Close-up of the tube-drawing machine, showing position of the saw immediately after cutting the tube to length

The tube is drawn by the man with the punty He simply backs off down the walk, holding onto, and perhaps manipulating, the punty The man with the blow-pipe blows into it and stands still The result is that a shell of hot glass flows off the end of the blow pipe, this shell rapidly diminishing in diameter for a while. Soon, however, the cooling glass in the shell nearer the punty has acquired sufficient stiffness to resist reduction in diameter. That is to say, at a little distance from the gob, the glass will get approximately its final diameter and will not reduce much as the punty man continues his retreat. The yielding is nearly all done at and near the gob and perhaps at and near the punty In between, lies the tube. It may be possible for the punty man to withdraw 100 or more feet. There will be waste at both ends.

The reheating end of the furnace, showing troughs and arbor

The machine method in part imitates this procedure. The molten glass in the great tank is allowed an exit into a special furnace, in connection with which the blow pipe is mounted. The glass flows into a short trough with one or more descending steps. Near the further end, the blow-pipe is mounted. But the vertical plane of the blow-pipe is transverse to the line of the trough. The trough has a delivery end, by means of which it sends the glass into the blow-pipe at an angle. The blow-pipe is rotatably mounted at its rear and in a wall of the special furnace. It also dips forward. The result of the stream of glass flowing on at an angle is that gravity and rotation combine to cause the end of the blow-pipe to receive a complete envelope of glass down to its tip. Pressure air is introduced into the blow pipe and it flows out at the end. This air has only a very mild pressure, however, as the glass shell needs but little assistance to prevent collapse. It is, in fact, understood that pressure air may, under favorable circumstances, not be required at all. On the other hand, the machine may be used for the drawing of glass rod. In this case, it is proper to close the end of the blow-pipe with a cap. The special furnace is provided with a means of heating the glass as it flows along the short trough with its stepped bottom and a separate means of heating the glass on the blow pipe.

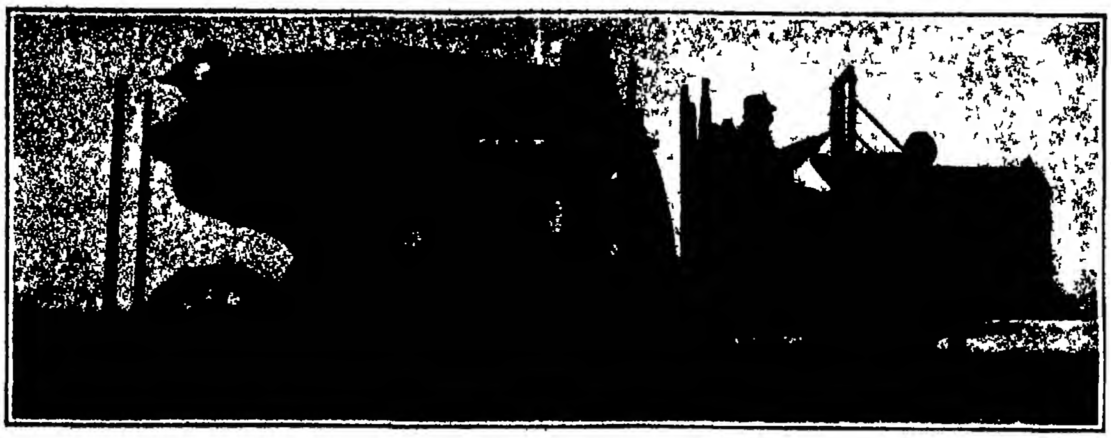
The end of the blow-pipe is preferably furnished with a sheath of heat-resisting material Consequently, the glass really flows onto it Further, a kind of muffle may be used for the purpose of equalizing the heat round the glass on the blow-pipe and of hindering the products of combustion from attacking the gob. When used, this muffle may be rotatably mounted, the rotation then operating to distribute heat.

When the glass tubing passes down and away from the special furnace, it soon finds itself on a long line of grooved wheels. These are near the floor of the shop. The tubing lies in their grooves as it moves on away from the furnace. Every other one of these wheels may have its supporting upright provided with asbestos guides. These are to prevent the tubing from riding up out of the grooves and off onto the floor

At a considerable distance from the furnace, say, 125 or 140 feet, the tubing enters a pulling machine. This, together with the cutting-off device at its forward end, is quite an intricate affair The pull on the tubing is effected, in part, by the co-action of two endless chains, one set vertically above the other A little reflection will, perhaps, convince the reader that this is not so simple a matter as, at first sight, it may appear The glass tubing is to be pulled along at a rate capable of adjustment The size of this tubing will vary from job to job. This means that some method of adjusting the space between the two chains will be required Then the grip in which the tubing is held must not be a rigid one. It needs to yield upon occasion. Naturally, it will hardly do to let the chains exert much pressure on the tubing between them at one end of the machine where one sprocket wheel is above another nor at the other end where a similar condition exists. At any rate, in the present apparatus, the grip on the tubing is effected in the region between the two pairs of end sprockets.

The links of each chain are pivoted to one another. Half way between the ends of each link and inside the side straps of the link is arranged a roller The function of these rollers will soon appear. There is a kind of saddle which extends longitudinally over each pivot-joint. This saddle is carried by the shafts or trunnions of two rollers. The saddles are arranged to cover the joints on the *outside* of the chain loop. They accordingly lie between the chains and the tubing as they pass through the region where the grip is effected. In fact, when these saddles are suitably provided with cushions they constitute the means of gripping and pulling the tubing.

However, it is necessary to force them to their duty. Otherwise, there would be no effective grip developed. This is done by providing two platforms, one above and the other underneath the working parts of the two endless chains. As the chains pass between the two platforms, each contacts with its platform by means of its rollers. They are the wheels which enable the chains to pass over the platforms without developing sliding friction. The under platform is unyielding and it is fixed in position. In effect, this providing a definite



A man's-sized job for any truck—hauling a six-inch disappearing-gun mount, an aggregate load of 30,360 pounds

level for the passing tube. The upper platform is divided into sections and these yield more or less. This upper platform is also adjustable vertically, and this takes care of the changes in size of the work that may be desired from time to time. The upper pair of sprockets may also be adjusted vertically. The arrangements are such that both upper sprockets are raised and depressed simultaneously and at the same rate. This is accomplished by means of a long shaft and of bevel gears. The pulling machine is operated by a suitable motor mounted on the carriage which supports the whole.

From the point of view of mechanical engineering, the cutting off device is perhaps the most notable feature of the entire plant. Off-hand, one might think it quite a simple matter to cut off a continually lengthening tube every time it grows six feet longer. But if one reflects a little, he will soon grant perhaps that unless the notching or cutting or breaking or any combination of these is done instantaneously, it may be necessary to *accompany* the continually lengthening tube. In the present device, one of the main operations of the severing is a notching with a rapidly rotating wheel. This wheel must dip and pause, as it were, and during the pause nick the glass with its flying edge. The pause here refers to the matter of approach to and recession from the surface of the glass. This pause means that the nicking is not done instantaneously, but that time is a factor. Now in order that the wheel may even for a short time stay with the tube at a given point, it must travel with the tube. The mechanism must therefore not only provide for the approach and recession but also for a movement with the motion of the tube. So the notch is made.

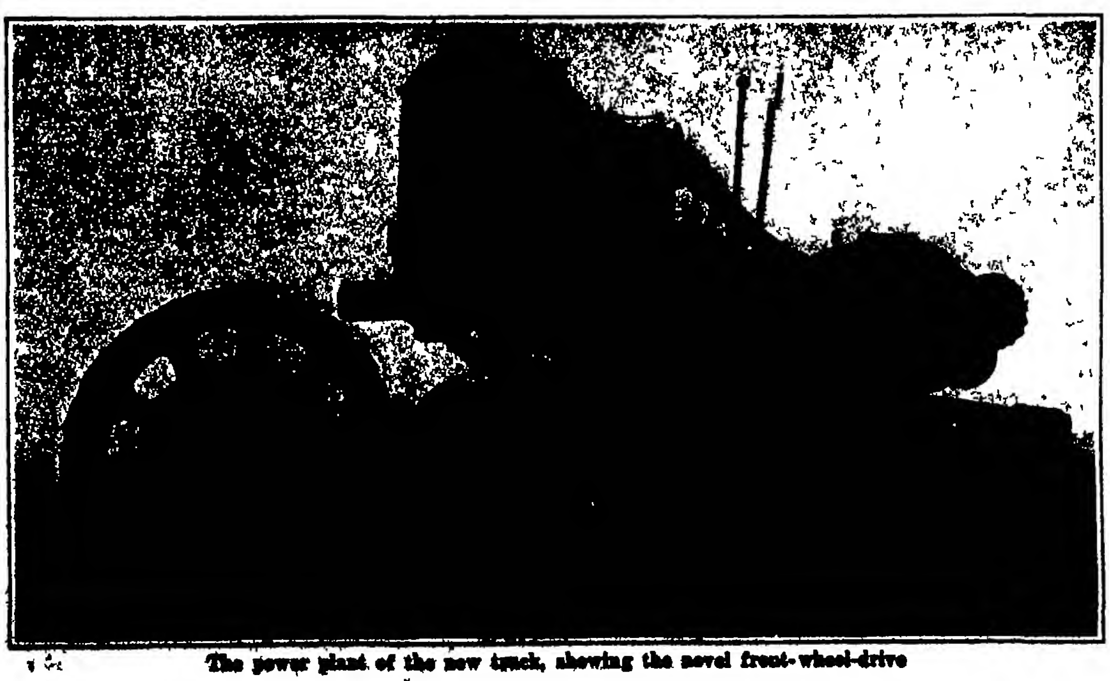
A wheel consisting of a series of long vanes receives the tube as it grows, the end being in between two of the vanes. When the break is made by a movement of the slotted disc forming one end of the system of vanes, the desired length of tube is already all the way in between a pair of vanes. Cut off, it rolls on one vane by gravity and escapes from the machine.

A Departure from Motor Truck Conventionalities

THE accompanying photos show a new motor truck with many novel features that is now being manufactured in San Francisco. Among the special features are hydraulic steering, three-point suspension and spring-mounted power-plant.

Using the regular steering-wheel principle, the hydraulic system connects the steering wheel to a simple hydraulic control which works automatically. The truck carrying a load of ten tons can be steered as easily as a passenger car. The driver can throw the wheels of a loaded truck from extreme to extreme with the vehicle standing still, without any physical effort other than the effort to move the steering wheel. The pneumatic steering device consists of a cylinder attached to the right side of the truck in front of the front wheels. This turns the front wheels as easily when the truck is motionless as when in motion, enabling the truck to be maneuvered into the most advantageous loading position under any conditions, without loss of time.

The main or load carrying frame is mounted on three points. This eliminates all frame distortion or weaving—one of the most destructive weakness to be met with in motor truck construction.



The power plant of the new truck, showing the novel front-wheel-drive

The spring mounted power plant has a great advantage because it protects the power plant against all shocks of road inequality, shifting load or careless driving. This makes for longer mechanical life and increased driving comfort.

The service brakes are instantly, positively and powerfully set by a simple application of the hydraulic principle.

Another feature of this truck is the unusually low-hung body. This truck is said to possess the lowest body of any truck manufactured, the bed being only 18 inches above the ground. This is made possible by the arrangement of the engine suspension in company with the front-wheel drive. Any doubts as to the practicability of the front-wheel drive should be dispelled by the photograph at the head of the page, showing the new truck successfully performing a decidedly heavy bit of hauling.

Protecting Fruit by Colored Light

A FEW years ago there was a good deal of excitement roused among the public by tales of the marvelous effects upon the general health and well being produced by exposure to blue light. More recently some very interesting experiments have been carried out with respect to the effect produced upon the growth and development of plants by various colors. Naturally, however, it would be out of the question to roof large areas of land with glass of one or another color in order to produce a given effect. An ingenious French botanist, M. Robert Lance, however, has gotten around this difficulty in a very clever manner by coating grapes and other fruits which it is desired to protect, with a solution containing a harmless blue coloring matter.

M. Lance's method is particularly designed to prevent fungus growths by means of a colored screen. He creates this screen by spraying the leaves, stalks, flowers, and fruits of the plants he wishes to protect with a clear solution which is obtained by adding green, blue, indigo, or violet dyes to water containing a support, such as sulfate of lime, lime, talcum, kaolin, etc. to which the dyes in question are attached by means of freshly precipitated alumina (alumina is a single oxide of aluminum).

M. Lance especially recommends a solution prepared as follows: Ultra marine blue, 650 gr., ultra marine green, 250 gr., ultra marine violet 100 gr. These amounts of the three shades of ultra marine are diluted with several liters of water and to dilute solution 2 kg. of sulfate of lime are added, besides 1350 gr. to 1400 gr. of pulverized quick lime. When the mass has attained a uniform color the dyes are attached to the base as a sort of lacquer by incorporating 1 kg. of sulfate of alumina or else 1.5 kg. of alum. The lime decomposes the sulfate of alumina or the alum, setting free the alumina which at once fixes the color upon the particles which are meant to support it, and at the same time gives more adhesive power. When the reaction is finished enough water is added to bring the volume to 400 liters and the mixture is then ready to be sprayed on.

M. Lance has modified this method for use in certain cases by adding to the spray an anti-cryptogamic substance. Zinc chloride and zinc sulfate are well known in medicine as antiseptics, so that if sulfate of zinc be added to the solution the latter will be even better as a germicide. To prepare this solution 1 kg. of sulfate of zinc is dissolved in 100 liters of water. 500 gr. of pulverized lime are added in order to precipitate the zinc in the state of the hydroxide and to decompose eventually the total amount of the alumina salt employed as a fixative, then with the mass thus obtained from 80 gr. 100 gr. of the dye stuff is incorporated. When this is done 250 gr. of sulfate of alumina or 375 gr. of alum are added, and the mixture is stirred vigorously for a quarter of an hour, it is then filtered, after which it is ready to use as a spray.—By *M. Tevis.*

Effects of Fire on Concrete

WITHIN six months two fires with similar characteristics occurred in a reinforced concrete warehouse at Galveston, Texas, according to an article in an American engineering paper, the observations of two engineer eye-witnesses on the behavior of the structure, with their conclusions, is as follows:

"The warehouse was a two-story building divided by 12-inch walls into independent sections 300 feet long. The design is simple, comprising 22 inch and 16-inch diameter columns spaced at 20-foot centers reinforced with vertical rods and spirals supporting flat slabs. The first floor was 9 to 12 inches thick with 4-inch drop head 6 feet square. The roof was 6 to 8 inches thick with 3-inch drop head. The floor loads of hemp were exceedingly heavy and in burning developed great heat. In the first fire the floor stood. In the second fire noticeable facts were the complete destruction of drop heads though adjoining flat slab was intact, and the weakness of construction joints in offering resistance to fire. The results of these fires show conclusively the great value of flat surfaces without sharp corners of any kind. Spandrel beams over doors were almost completely destroyed, although flat slabs adjoining remained nearly intact. Drop heads and beams suffered similarly."

How Much Water for the Crops?

Development of an Automatic Transpiration Balance by Government Scientists

By George H. Dacy

AN ingenious automatic transpiration balance has been devised by the scientists of the National Department of Agriculture who are conducting investigations to ascertain the water requirements of various kinds of plants. The water requirements of a given crop, or the transpiration ratio, has long been known not to be constant, but to be dependent on and influenced by variations in many environmental factors, such as the temperature and humidity of the air, the velocity of wind, the intensity of solar radiation and the fertility of the soil. The water requirement of small grain crops grown in a cool, humid region is much lower than that of the same crops when grown in a dry region, such as the western part of the Great Plains, where they are subjected also to high winds and great solar radiation. The matter of the water requirements of plants is of great economic importance in connection with the agriculture of the semi-arid regions, since the crop or variety which is most economical in the use of water, other things being equal, is evidently the one best adapted to regions having a limited water supply.

Heretofore, plant transpiration experiments have been conducted under great difficulties, as hand spring balances have been used to weigh the growing plants potted in special galvanized containers in order to keep tab on the amount of water they received and the amounts they transpired or which evaporated. By using galvanized containers with close fitting covers provided with openings for the plants and sealing the openings around the stems of the plants with wax, the national farming experts eliminated the loss of water due to evaporation. The large pots of plants were weighed once daily and were maintained in a screened inclosure to protect the experimental plants against birds and possible hailstorms. These tests have shown that alfalfa is far higher in its water requirement than most of the other popular farm crops. It requires double the amount of water that wheat and other small grains do, three times as much as corn and four times as much as millet or sorghum. These results indicate the impracticability of growing alfalfa in regions of limited rainfall when forage crops like sorghum or millet are available which will produce the same amount of dry matter with one-fourth the amount of water. Varieties of the same crop show measurable differences in their water requirements. This suggests the possibility of developing strains which are much more efficient in the use of water than those now grown in the dry-land regions.

The new automatic weighing apparatus devised by Uncle Sam's expert agriculturists is so arranged that the experimental plants can be exposed freely and continuously to the weather. A small platform scale with agate bearings having a carrying capacity of 200 kgm. and a sensibility of 5 gm. is used as the foundation of the automatic apparatus. This scale was fitted with a short column so as to centralize all the mechanism below the level of the top of the pot in which the test plants were grown. The auxiliary equipment of the automatic balance consists of a special, ball-dropping device, a ball receiver on the beam, beam contact and mercury cups, oil dashpot on the beam, a spring motor for raising the beam, an adjustable counterpoise for raising the center of gravity of the balanced system, a recorder for registering the exact time at which each ball is dropped, batteries and relays and a case for protecting the mechanism from the weather. The operation of the mechanism is simple and efficient. As the plant decreases in weight due to transpiration, the beam of the scale falls until an electric contact is established at the front end of the scale. This closes a special relay circuit with the result that the ball-dropping device deposits a ball in the conical cup shown in one of the accompanying illustrations. The weight of this ball tends to raise the scale beam. The spring motor by means of a special cam arrangement raises the beam promptly and positively to its upper position and as this is done, the time of the event is indicated on the drum of the recorder.

The conical ball receiver is suspended from an extension of the scale beam on the same side as the plant load so that the added weight of the ball compensates for the loss which the plant suffers by transpiration. The ball receiver is suspended from a knife-edge which lies in the plane determined by two other knife-edges on the beam. The distance from the central knife-edge is so chosen that the weight of the ball corresponds to a change of 20 gm. in the weight on the scale platform. The dropping of a ball into the receiver is ordinarily sufficient to raise the opposite end of the beam and open the circuit. It sometimes happens, however, when the transpiration rate is high and a gusty wind is blowing, that the beam remains down until the transpiration has been sufficient to require a second ball to counterbalance the loss in weight suffered by the plant. Under such conditions the balance would fail to operate without the intervention of some protective device. This protection is secured by a spring motor which raises the beam to its upper position each time a ball is dropped and then leaves the beam free. The motor which consists of a strong 8-day clock movement equipped with a fan to reduce the speed is controlled by an electro-magnet. When the beam circuit is closed, this motor is released and raises the beam by means of the cam. When the cam shaft has completed one revolution, the arm on the cam shaft again engages the spring on the armature of the magnet and the motor is stopped.

A convenient type of recorder for registering the time at which each ball is delivered has been devised by Doctor Marvin, Chief of the U. S. Weather Bureau, for use in connection with automatic rain gages. This recorder has a drum 12 inches in circumference which makes one revolution in six hours and is continuously offset by a screw so that the four 6-hour periods are recorded side by side on the same sheet. A valuable feature is a zigzag attachment on the magnet by means of which the tracing pen is permanently displaced each time the magnet circuit is closed. This gives a graph which is much easier to read than the ordinary record in which the pen returns to its initial position when the circuit is opened. The dropping of two balls in rapid succession is easily seen in the zigzag record on account of the double offset but is difficult to determine in a record of the ordinary type. The automatic transpiration balance works very satisfactorily except in the presence of whirlwinds or sudden gusts which lift the experimental plants and tend to give a transpiration rate which is momentarily too high. The use of this novel apparatus is aiding our Federal farming experts to ascertain facts about the water requirements of plants which previously have been impossible of determination owing to the lack of a satisfactory and efficient experimental apparatus.

Left: Unsatisfactory and cumbersome old-fashioned method of conducting plant transpiration tests. *Center:* Four automatic balances used in investigation by Government farming scientists. These machines accurately record the transpiration losses of plants as they grow. *Right:* Front of balance with cover removed, showing mechanism. The spiral glass ball container is noticeable in the upper right-hand corner, the balls passing down through the ball dropper into the basket at the extreme right. The spring motor for raising the beam is shown at upper left-hand side. The dashpot appears below the weight carrier

The old and the new apparatus employed by Government farming scientists in determining plant transpiration

How Long Can You Hold Your Breath?

WHILE Nature has wisely made our heart action involuntary she allows us to have a certain amount of control over the equally important function of respiration. This is doubtless because it is not infrequently of advantage, as in case of danger of suffocation from smoke, water, noxious gases, etc. The time during which one can hold the breath is extremely brief, however, even at best. According to some recent experiments by two French physiologists, MM. L. Binet and M. Bourgeois, reported in the *Presse Médicale* (Paris) for June 12, 1920, this is not more than 40 to 45 seconds for a normal adult in a state of rest, or a little bit longer if the person is lying down. This time can be considerably increased by training as in the case of expert divers.

But the most important result of these experiments is the demonstration that the capacity for holding the breath is affected by disease of the air passages or of the heart in such a manner as to form a valuable means of diagnosis [illegible]

The Giant's Causeway

ONCE upon a time, in the northeast corner of Ireland, where the Emerald Isle faces the coast of Scotland across a comparatively narrow expanse of St. Patrick's Channel, there dwelt a mighty giant And by a curious coincidence the corner of Scotland nearest to his domicile was inhabited by a Scotch giant, of equally forbidding appearance. The Irish giant got to worrying about which of the two of them was the better man and he worried about it until he decided that the question would have to be settled one way or the other. So he shouted across to the Scotch giant a challenge to come over and fight him. The canny Scotchman expressed an entire willingness to oblige, but pointed out that he had no way of crossing the channel. The Irish giant then said that he would build him a bridge to cross on, if he would for sure cross on it and fight; and to this the Scotch giant agreed So the Irish member got himself to work, and constructed a tremendous causeway of solid columns clear across the water to Scotland and when it was done, the Scotch giant crossed over and the big fight was pulled off Press facilities at that time were not what they are today, so there is no certain indication who won the fight —it all depends upon whether it is an Irishman or Scotchman who tells the story. But this much is certain the causeway that the Irish giant built for his adversary to come over on is still there, and anybody may inspect it who doubts the accuracy of the story and wishes to see the evidence for himself

To abandon the field of romance and come down to that of geology, the north coast of the County Antrim is notable for the promontory of columnar basalt to which the legend retailed above has given the name of Giant's Causeway These pillars are close-fitting, irregular hexagons in section and made up of jointed lifts varying from a few inches in height to some few feet These portions are convex or concave at their upper or lower ends, so that they fit neatly into one another; so far as we know no exploration has ever determined the depth to which the formation persists, though some of the pillars are exposed for as much as twenty feet of their length The causeway is from 20 to 40 feet wide, and highest in its narrowest point It extends outward from the cliff into the water, its upper surface taking a slight downward slant but one insufficient to make walking on it difficult, and after 100 yards that is always above water it reaches a height where it is submerged at high tide, and then runs on out until it is completely lost beneath the water—and beyond The neighboring cliffs exhibit in many places the same formation. So extraordinary is this formation that at least one [illegible] authority [illegible] while exercising [illegible] not to express [illegible] opinion as to its origin. In spite of this [illegible] attitude, the Causeway may be characterized [illegible] in origin and lavatic in composition. [illegible] the molten matter to solidify in [illegible] columnar form, however, must remain [illegible] mystery.

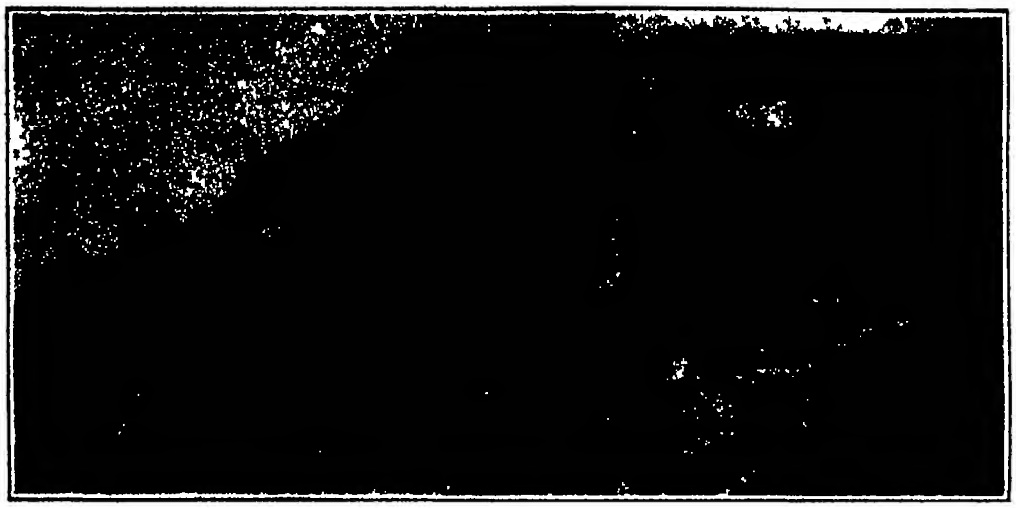
[illegible] of having read, in support [illegible] the coast of Scotland shows solid [illegible] formation, but at the moment [illegible] this. Perhaps the Scotch giant [illegible] as well.

Planting Onion Sets by Machine

IN the Pleasant Valley onion district of Iowa onion sets will be planted the coming season by machine This machine plants the sets ten times as fast as a man does. Mechanically, the designing of a planter which would handle onion sets presented no great problems the difficulty, indeed, was of another color A machine which could distinguish between the top and bottom of a set was obviously impossible Growers however, had always planted their sets right side up

The feasibility of an onion set planter accordingly hinged on the question of whether or not the way a set was placed in the ground mattered The machine would not only necessarily drop sets sometimes bottom side-up—others would be left in all conceivable positions. For four years experiments at Pleasant Valley have been under way to settle this question definitely once and for all

These investigations have demonstrated that it makes no difference how the set is dropped in the ground This is in the production of globe onions which is the commercial crop at Pleasant Valley For green onions or spring onions it is still desirable that the sets be placed by hand



Where Alaska's coal outcrops in two forty foot veins

Copyright R. H. [illegible]

The Giant's Causeway, in the north of Ireland—a natural formation of extraordinary character

Most of the onions Americans eat are grown from seed, not from sets. So, in the first place the desirability of an onion set machine planter hinged on the desirability of sets Sets have come into general use in this Iowa district because of an onion pest thrips Onions from seed became more and more uncertain As sets began to be used seed onions became more uncertain still, because thrips would migrate from set planted fields to the later onions growing from seed All these things are behind the adoption this year of a machine planter for sets.

Alaska's Coal Fields

ONE of the elements that makes it almost futile to estimate the length of the period during which the human race will have coal available to meet its power and heating needs is the existence of deposits that have never been worked All over the world these are to be found and naturally little is known about the character of the coal that they will give or the amount that we may hope to extract from them They vary in size from the one-man deposit in a country where coal mining is not generally indulged in In eastern Ohio it is an unfortunate farmer who has not got on his land at least one coal outcrop which he could work if he wanted to to the millions of tons known to underlie a large part of the area of China

Among the deposits of this character that should be of more immediate interest are those of our own northern province of Alaska It is estimated that these coal fields cover some 20 000 square miles and it is known that the coal is of the highest grade and of great thickness Our photograph is taken along the Tanana River and shows two veins each forty feet in thickness outcropping one above the other In this region there is coal enough to make amply worth while the development of the district but the Federal government's regulations, to put the case mildly are not such as to encourage the undertaking while the transportation costs to any point of large consumption are so problematical as to make it problematical when the deposits will be worked But they are always there constituting a material reserve of coal against acute emergency

The Uva-Chrom Process of Color Photography

THE methods of color photography thus far employed have had the disadvantage of demanding a rather long time of exposure They are usually known as 3 color process and are based upon the fact that all colors can be produced by the mixing of 3 primary colors —red yellow and blue A writer in *Reclam's Universum* for May 1921 describes a new process known as the Uva chrom process by means of which the time of exposure can be much shortened Whereas in the 3 color process the times of exposure bear the relation 1 4 7 in this new process the ratio is 1 1 1 Hence the period of exposure may be shortened to 1 second or even in some cases to ¼ of a second in which case of course a large diaphragm or shutter must be employed

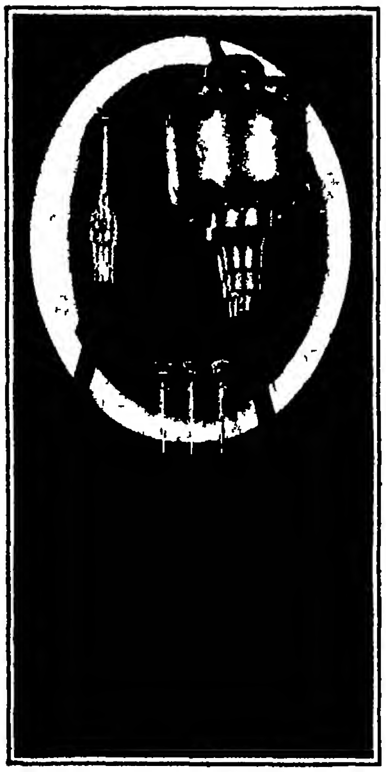
By the use of this new method a considerable advance is made toward the long hoped for goal of taking photographs in natural colors, and experiments along this line are already very promising

The Uva-chrom photographs are exceedingly clear cut and distinct and the colors are reproduced with admirable faithfulness this is true of interiors, which ordinarily offer a good deal of difficulty Since the pictures have no "grain, but are produced on the smooth plate, or rather on the emulsion which covers the latter a comparatively feeble source of light is all that is needed—*e g* a half watt lamp connected with the wiring of the room

For outdoor photography of every sort the reduction in time of exposure is a decided advantage It is only under selected conditions that exposures of over a second can be made of most of the common objects about us, as every amateur photographer well knows

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



The electric toothbrush

An Electrical Tooth-Brush

WE may still lack the electrical face-washer, the electrical collar-and-tie fastener, and the electrical explorer for restoring dropped collar buttons to us from their hiding places, but we are coming on nevertheless. Most of us may be supposed to have been to the dentist at one sad time or another and to have had experience with the industrious little dinguses with which he digs holes in our teeth. Certainly this electrical mode of attack is more effective than hand work would be. And if this is the case, why not employ it in the homely every-day job of toothbrushing? The outfit that we illustrate echoes "Why not," indeed. The apparatus is six inches and a half wide by eight and a half long, it can be attached to any bathroom wall and driven from any lamp socket. And it will clean your teeth better than you ever cleaned them by hand.

It registers amperes per square foot of plating surface

A Meter for the Electroplater

LESS than ever need the electroplater, with the foot-ampere meter here illustrated at his disposal, depend upon guesswork. This meter consists of a small ammeter conveniently mounted with a special electrode which is submerged in the plating bath when the instrument is hung on the tank rod and which causes the dial to register the amperes per square foot of current flowing to work or from anode.

It requires but a few seconds to take a reading, and the plater needs but to hang the instrument in different parts of the plating vat to measure the current density at any point. The satisfactory results are obvious.

Recent Patent Decisions

Inspection of Litigant's Records.—In a suit by the McLeod Tire Corporation against the B F Goodrich Co, and on a motion by the plaintiff to be allowed to inspect plans and drawings, etc, Judge Hand said

It has been the practice in this district to attempt to simplify the issues and limit the testimony necessary at the trial by allowing inspection and compelling answer to interrogatories in patent cases very liberally. We have stopped little short of requiring almost everything except the names of witnesses and such information as would enable the interrogator to bring forward untruthful testimony to meet the evidence of his adversary

"The only objection to requiring inspection of working drawings or blueprints from the records of the defendant showing molds cores, and other working parts which have been used in the commercial production of defendant's tires is because of the contention that these represent the details of a secret process of manufacture employed by the defendant. Even if these things are secret they could be produced at the trial, so that I do not see how the privilege can be preserved absolutely. I therefore grant the inspection called for. *McLeod Tire Corp v B F Goodrich Co U S D C of N Y*

Patentability of New Alloys.—Appeal from a District Court from a suit wherein the decree was for the complainant. Reversed

The patent relates to alloys of iron and steel and particularly to the latter, where nickel is employed as one of the alloying metals, and the object of the invention is to produce an extremely tough metal with great resistance to shock

The Churchward patents for an alloy of steel are held void for want of patentable invention. The point of law deduced is that novelty, in the sense of the patent law, in the proportion of basic metals used in an alloy, involves not merely figuring out proportions differing from any known before, but new results from the new proportions, developing a new metal or an old metal with new characteristic of structure or performance *Bethlehem Steel Co v Churchward Steel Co. U S C C A of Pa.*

The Right of a Licensing Patentee Against an Infringer.—The defendant admittedly sold its products as Tweedie boot tops. But the defendant contends that since the Tweedie boot top is made and put upon the market by the Tweedie Footwear Corporation under an exclusive license, the plaintiff individually has no interest left therein which he is entitled to protect by a suit in his own proper person as patentee

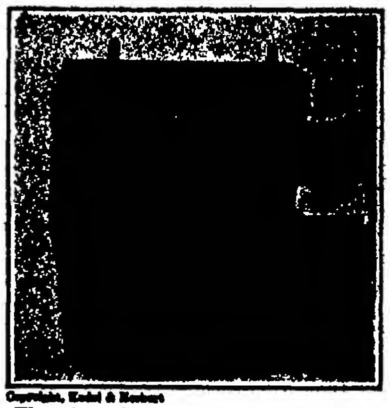
Finding is for plaintiff. In an action by a patentee to restrain infringement of plaintiff's patent, and also to restrain defendant from using plaintiff's name in and about the sale of articles infringing plaintiff's patent (that is, for unfair competition), the question whether, since the article patented by plaintiff was made and marketed by a corporation under an exclusive license, the plaintiff had sufficient interest left therein to sue to restrain unfair competition, would not be considered on proof of but one sale by defendant of an article not bearing plaintiff's name, although the sale was made in response to a call for plaintiff's article, where such sale was made for the sole purpose of making the case upon such question *Tweedie v Royal Co. U S D C of Mo*

Invention in Process Patents.—This is an application for an injunction to restrain alleged infringement of a patent covering a process of separating the moisture from liquids. The defendant is engaged in the business of condensing and pulverizing milk. The application is resisted on the ground that the patent is invalid and that the defendant is not shown to infringe. In a general way the process consists in introducing the milk to a concentrating chamber wherein it may be heated, and wherein also a vacuum is maintained for condensing purposes. When the product has been condensed to a requisite degree, it is withdrawn through a pipe and introduced

(*Continued on page 237*)

An Alarm to Foil the Hold-Up Man

HOLD-UP men who have been specializing in the robbery of bank messengers and payroll carriers will not rejoice in the invention of the latest security satchel, designed as it is to prevent their silent getaway. The satchel is ordinary enough in appearance, save that it is of steel. In the lid it carries a monster bell, operated by two dry cells which are capable of ringing the alarm continuously for six hours. The switch is hidden in the grip handle, and has two buttons, so arranged that when the messenger discovers that he is being held up he can instantly push one of them. The alarm will go off and stay off, and can be heard for a distance of half a mile. The second button is for previous adjustment, and leads to a delayed action that holds the ringing up for ten or twenty seconds—enough to enable the messenger to make his getaway from the immediate range of the hold-up man before the latter discovers what he is up against. We must agree with the inventor that no crook is likely to march through the streets carrying a ringing satchel, or to get very far with it if he attempts it. Certainly, until the stick up artists learn how to put the muffler on the bell instantly and permanently, the new trick ought to be effective. And that is all that could be asked, for the man who is coping with a crook must expect to change his plan of campaign as fast as the crook learns what it is.



Copyright, Kadel & Herbert

The alarm-bell satchel for bank messengers

The Square Deal Gas Pump

SO far as a careful checking up of our gasoline mileage can tell us, we do not get cheated on gasoline in the metropolitan district—in fact, if anything in the nature of error is made, the pump delivers a bit more gas than we pay for. But in less fortunate districts the swindle pump still holds sway, and anything designed to put it out of business is welcome to the motorist. Such a device is the one illustrated herewith, which pumps the gasoline from the underground storage chamber into a hollow glass container at the top of the stand. This glass is filled and emptied into the tank of the car a gallon at a time, in the language of the manufacturer, it delivers while measuring and fills while it delivers. It protects buyer and seller and operator against any controversy. It is of particular interest to the boss seller, because each of his employees has a key and can operate the pump only by the use of this key, and at the end of the day the pump yields a printed record, on cash-register tape and in cash-register style, of the day's business.

The gasoline pump with visible measuring

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Saving Food Fish by the Hundred Million

(*Continued from page 216*)

normal health and well-being of the fish

The fish training camps where the rescued members of the finny tribe are hardened for transportation to inland waters are located at La Crosse, Wis., and Bellevue, Iowa. At these places the fish are maintained in special tanks without food through which cool, clear water flows continually until they have recovered from their landwreck experiences sufficiently to be shipped to new homes. The Bureau of Fisheries now uses all steel distributing cars equipped with the most modern and efficient conveniences for fish transportation. These cars are always hauled on fast mail trains so that the fish will be in transit as short a time as possible. Sometimes a carload of fish is sent to one place while on other occasions the shipment consists of a mixed carload for several different places. Often farmers in wagons or automobile trucks meet the fish train and receive their quotas of the fish which they have requested for stocking private and public ponds and lakes.

The fish rescue work has never been able to develop on the economic scale which local conditions along the Ohio, Illinois, Missouri and Mississippi Rivers justify because Congress has never seen fit to make definite annual appropriations for the extension of this work. At present the rescue work expenses come out of the general fish propagation and improvement funds allotted to the Bureau of Fisheries. The annual rescue of landlocked fish is minute in proportion to the vast numbers which are lost due to the non-development of this efficient method of conserving our food and game fish resources. There are stretches of river bottoms in the Mississippi Valley over 500 miles in length which yearly suffer from uprisings and overflows where absolutely no fish rescue work is conducted despite that the losses of valuable foundation fish stock are excessive. A little rescue work is now being done along the Illinois River and these activities should be extended expeditiously to cover the Missouri and Ohio Rivers also. The states that border on the Mississippi should demand of their Government representatives that more extensive and detailed attention be devoted to the saving of food and game fish carried by floods from their normal places of abode to landlocked locations which sometimes are several miles inland from the river channels.

Recent Patent Decisions

(*Continued from page 226*)

into a desiccating chamber under pressure through a spraying device, and immediately carried through such chamber under the influence of air or gas as a desiccating agent, whereby evaporation takes place to such a degree that the particles of solids are precipitated and removed, after passing through a screen, from a collecting chamber.

The injunction is awarded, and the Merrill-Soule patent is held, in view of its general use, to disclose invention.

Where claims for a milk drying and pulverizing process were allowed by the patent office, the fact that other manufacturers, after the expiration of the patent covering the pulverizing process, deemed it necessary to use the condensation before pulverizing, shows that the claim of patentee that he produced an improved result, which was an invention, and not a mere aggregation of former processes, is well founded. That it would be possible to achieve the result obtained by the patentee by the use of old processes with greater care and skill than had been formerly used does not disprove invention, since the elimination of the necessity of great skill may itself show an improvement, evidencing invention. *Merrill-Soule Co. v. Milk Products Co. U. S. D. C. of Wis.*

New Wine in Old Bottles.—The patents in this suit have to do with devices used in the sharpening, by grinding, of those cylindrical metal-cutting tools known as milling cutters. The essential elements of the machine are a grinding wheel and a spindle head, for holding the tool to be ground, so adjustable with relation to each other as to bring the grinding wheel to act upon the edge of the tooth at the desired angle. The machine is also equipped with an adjustable arm, bearing what is known as the tooth rest, upon the end of which the tooth is supported while ground.

It is contended by the defendants that there is no invention. It is also contended that the patent in question was anticipated by various devices and publications. It is held herein that the De Leeuw patent which is the one in controversy is valid and not anticipated, and also infringed.

The mere adoption of common expedients in adapting an existing machine to a new use is nevertheless invention where the thought of the adaptation is new. *Cincinnati Milling Mch. Co. v. Oakley Tool Co. U. S. D. C. of O.*

Pearls in Plants

FEW people realize that there are such things as vegetable pearls. Yet now and again, in certain tropical plants curious hard round substances are found which one may properly call pearls, seeing that their composition is almost identical with the product of the oyster. For instance, occasionally in Java these substances are discovered in the joints of bamboos. On analysis the bodies are found to consist of almost pure carbonate of lime—the same substance which goes to the make-up of the pearl of the oyster. Now and again similar bodies are found in the endosperm of the cocoanut while these plant pearls are known to occur in the wood of the pomegranate and teak trees. These vegetable pearls are sometimes as large as a hazel nut although as a rule they are somewhat smaller. Exactly how the vegetable pearls arise is not fully known. They are generally believed to be due to an excess of calcareous and silicious matter in the plant. The plant pedals are rarely seen apart from the East Indian islands for they are highly valued as charms. The owner will not part with one for any figure seeing that as long as he holds the pearl he considers that he will be immune from all ills which commonly assail mankind.

Fooling Fish With Colored Nets

DURING a journey of exploration to Dalmatia, Dr. Rudolf Ditmar of Graz observed that the Dalmatian fishermen used nets dyed in wonderful shades of brown and bright green. Searching inquiries on his part brought out the fact that the green nets were dyed by means of an extract made from the *Pistacia butiscus*, while the brown nets were colored by a dye obtained from the bark of the *Pinus maleprnsis*. The fishermen dye their nets by no means for the sake of mere picturesqueness. They have found by experience that while the fish are canny enough to fear the white nets and flee from them, as from a danger signal, they swim calmly into the meshes of the green and brown ones. It seems probable that this is because the green and brown strands of the nets are not unlike the floating strands of seaweed, though another explanation which has been suggested is that the eye of the fish is unable to distinguish these two colors from that of the sea water.

The dyes in question are extracted by means of fresh water from the bruised bark of the plants mentioned above. After the nets have been well soaked in these natural dyes and then thoroughly dried, the colors are found to be fast both as regards water and sunlight. These natural dyes are also used to color the sails of the boats and they possess the further advantage of containing oils and tannins which exert a preservative action

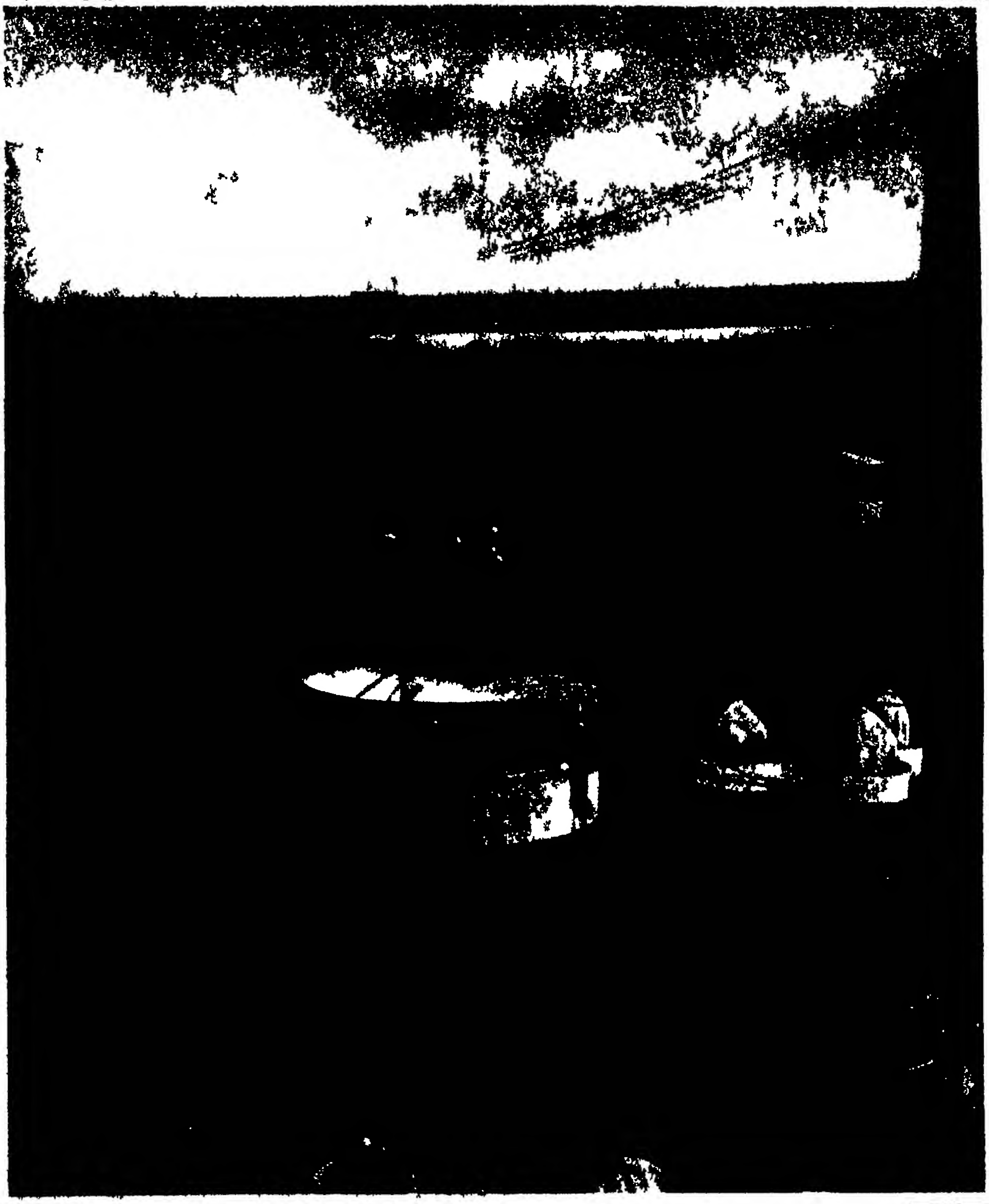
IN THIS ISSUE:

NEEDED—A NEW ARMY UNIFORM
THE ROLE OF CHEMISTRY

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS



FIRE-CONTROL PLATFORM, U S S. "PENNSYLVANIA" AS SEEN FROM BROOKLYN BRIDGE

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Electrification of Merchant Ships

THIRTY YEARS AGO we had "horse cars," four-story office buildings, oil and gas for lighting, factory power from a single steam engine, and the old "steamboat."

TODAY we have electric street and interurban railways, electric locomotives, fifty-six story office buildings, individual motor driven factory machines, and we are electrifying ships.

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SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXV] NUMBER 14]   NEW YORK, OCTOBER 1, 1921   [18 CENTS A COPY [20 CENTS IN CANADA

Something New in Electric Furnaces

By E. F. Cone

AN electric furnace with a repelling arc is the latest addition to the important industry of melting or refining steel or non ferrous metals by electricity It is unique in many respects and is a highly interesting addition to this industry It is really an electric torch It has been developed by a Chicago electric furnace company and is already in use in melting brass and copper and in making aluminum steel It is known as the von Schlegell repelling arc furnace and is the in vention of the president of the company A brief description follows

Many electrical people have asked what we mean by the phrase "repelling arc," what are its advantages and why It is a self regulating flaming arc torch which can be operated from 220-volt motor circuits and suspended into various kinds of chambers for high temperature with deoxidizing conditions maintained.

In answer to the question, "What is the repelling arc?" we offer a drawing which reveals the reason why we call it a torch suspended in a furnace body By dotted lines we have indicated the electrodes in a relapsed position which the electrodes take when there is no current passing The bottom ends touch each other They are drawn together by adjustable weights, as indicated As soon as current flows, the repulsion between electrodes and the flow forces the electrodes apart, thus drawing the arc

The electrodes, it will be noted, are placed about the same as electrodes are placed in a flaming arc lamp and the arc is very similar to that given by a flaming arc lamp. It will be noted that the operation of this arc differs from that of other arcs in that the usual practise in drawing arcs is by longitudinal movement of the electrode, while in this case it is entirely accomplished by lateral movement and the repulsion between electrodes is the force which gives this lateral movement. This repulsion also drives the arcs down from the ends of the electrodes.

One of the most desirable things in electric arc furnaces is to overcome the fact that with the changes of temperature and melting of the material in the furnace, as well as the wear of electrodes, the influences affecting the current in the arc are constantly changing to make the arc unsteady.

Another important advantage is the fact that because the electrodes can be raised and lowered as a unit, or in a cluster, rather than individually, it is possible to use gas-tight electrode joints. This prevents any flame coming up around the electrodes, prevents the rapid wear on electrodes which occurs in other types of furnaces, and obviates the necessity of water-cooled electrode holders.

The fact that all three electrodes are handled in a cluster, and that the arcs are inherently self regulating, makes it possible to suspend the same cluster or torch alternately in either one of several furnace bodies Thus there may be instances where the industrialist has two furnace bodies with the torch suspended into one, while the other is being charged and preheated with oil This really makes possible the use of two furnaces with the cost of but one set of electrical equipment One shell may be basic and the other acid or the two shells may be used for melting different metals.

On the von Schlegell furnaces no adjustment is made of the electrodes during heats. The torch is merely lowered during the process as the material melts down

Other applications of this torch for industrial purposes would be in heating furnaces for forging, melting the alloys and heating large ladles preparatory for adding charges, for work on non-conductive materials, particularly such classes of metallurgical work where it is desired to hold an intense heat within a body of ore or sand, similar to the manufacture of manganese, glass, etc

General view of the electric furnace with the repelling arc, and a sectional view and details of this new form of electric furnace

Artesian Reservoirs for Intermittent Supplies of Energy

THERE are many sources of power in Nature—the sun's radiation, wind, the tides and waves of the sea—which could be turned to the use and convenience of man were it not for the difficulty that they are intermittent or irregular, whereas practical applications in general demand a more or less constant supply This difficulty would be overcome if a cheap method of storage could be found, such as would enable the deficiency of the lean periods to be made up by the surplus of the fat ones

A Rumanian engineer Mr A Beldimano, sends an interesting suggestion for the solution of this problem, based on his experience in the oilfields of his own country He points out that as is well known to geologists and practical oil engineers, clay strata even when only a few feet thick, are absolutely gas-tight and water tight, as is shown by the fact that natural gas has been kept compressed under them, at a pressure perhaps of 100 atmospheres, for thousands of years, until man began to piece them by sinking wells He therefore proposes to drill deep artesion wells at the highest point of an anticline where a water stratum is to be found beneath a fairly thick clay stratum and to drive his energy in the form of compressed air into the well, when the air will replace the water in the pores of the sand of the water stratum In this way he would obtain a cheap and absolutely air tight container of any desired capacity In connection with this plan he points out that in Germany old disused collieries have already been used as reservoirs for storing air under pressure, being rendered air tight by a lining of clay The compressed air in the reservoir could be conveyed by pipe lines to any desired point and used in motors for the production of mechanical power, or an electrical power station might be established at or near the reservoir and the power transmitted electrically

The second part of his scheme contemplates the production of large quantities of compressed air at a pressure of say 10 atmospheres from the energy of the waves of the sea, continues *The Times Engineering Supplement* For this purpose he would anchor pontoons in the sea at a suitable distance from the shore and would install in them air compressors with a simple mechanism operated by the varying tension on the mooring line as the pontoons are moved up and down by the waves The compressed air thus obtained would be conveyed by pipe lines to the artesian containers on land Mr Belimano points out that this method of harnessing the waves would require no pier or masonry work on shore, and that the pontoons containing only the simplest engines, which would need no attention except for an occasional inspection a few times a year, could be constructed in any shipbuilding yard and need only be moored in a special way by anchors, like lightships. As the size of the power plant would depend on the number of pontoons in operation, it would be possible to begin with a comparatively small installation, and subsequently enlarge it, according to requirements Both these schemes seem most ingenious on their face, but their practical value remains to be proved in actual test

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The Illuminated Highway

MODERN highway engineering has ramifications that would have transcended the imagination of a Telford or a Macadam. Consider the matter of highway lighting, remembering that it is a bare century since street lights in the largest cities had any function other than the mere marking of corners Surely a generation ago any suggestion that our ordinary highways over the countryside might ultimately be lighted would have seemed fantastic

Yet today one of the outstanding problems of highway practice arises from the effort to light the way of the motorist in the open country Here less than in any other detail of highway construction and maintenance has current practice crystallized into an accepted standard Today we admit, even when we do not build our roads of concrete, that concrete is the stuff for roads We agree that the grade crossing is tolerable only as an expedient But with regard to the character of highway illumination at which it is desirable to aim we are still a good deal at sea.

The idea behind all road lighting is simple enough Even at the crawling pace of horse and buggy, driving is safer when one can see the road ahead. At the automobile's speed the hazard of darkness is so increased that some means of illumination becomes imperative It was not possible for the horse-drawn vehicle to display a light which should do more than announce its presence With such complete illumination as is afforded in city streets it is not necessary for the automobile to go beyond this, as the universal use of the dimmest of parking lights in city driving attests

In the country, pole lights have not been needed for ordinary purposes and have not been installed When automobiling attains a degree of generality which demands effective lighting, it is therefore necessary to make a choice between the pole light and the head light The disadvantages of the latter have been unduly emphasized and its advantages have had too little attention It is true that a light which dazzles the approaching driver is a source of actual danger rather than of safety Ten years ago this might have been a pertinent objection to the headlight—but ten years ago nobody was proposing the use of the pole light as standard highway practice Today, when it is not alone proposed but in large measure practised, the objection to the headlight upon which it is chiefly predicated has been met The man who drives with a dazzling light does so by choice, and should have as little consideration from the community as he gives.

The average highway passes through more or less of wooded or shaded territory, it curves with a good deal of freedom, it is liberally sprinkled with hills, long and short, steep and gentle The presence of trees means that the pole light, no matter how skilfully located, will throw shadows upon the roads and this condition is greatly accentuated by curves, which make a greater length of road susceptible to the influence of a single light Everyone who has ever driven in the country at night knows how puzzling these shadows may be when at rest, how alarming when in motion The wholesale trimming of the trees would perhaps be a remedy, but we do not suppose it will be seriously advocated We have yet to see, on the other hand, a headlight that will throw a shadow save where there is really an obstacle in the road, and it is more likely to show this obstacle in its true form than as a silhouette whose real significance must be guessed. Again, where the roadside is comparatively unobstructed, every little curve and every slight rise means that two consecutive pole lights will take on the appearance of an approaching car—or, much worse, vice versa. The combination of shadows with horizontal and vertical displacement of the lights lends to a long night drive over an illuminated road the character of an obstacle race—with the added touch that one must guess the location, the character, and even the reality of the obstacles.

For night driving along any road that was ever built our opinion is that no competent driver need ask anything more than the illumination of his own headlights, with single lights on the outside of the curves at the discretion of the authorities. These, however, should be frosted or otherwise fixed so as to throw no beam and hence no shadow It would hardly do to make them red, it is hard enough to distinguish between the car ahead and the warning signal that marks the ditch-digger's unfinished work, without adding further complications. Points of real, active danger might be marked with a pattern of red lights, which could hardly be mistaken for anything save what they are.

Before spending a lot of money in cluttering our highways up with a vast number of useless and meaningless and confusing pole lights, would it not be well to pause for a moment and inquire whether the present status of the headlight is not sufficiently satisfactory to justify us in the expectation that whatever illumination a driver needs he may carry with him? Will not better satisfaction be got, in the long run, by confining the roadside light to the rôle of a signal?

Stretching the Electric Transmission Line

SOMEWHAT startling are the experiments recently conducted at the high voltage engineering laboratory of the General Electric Company at Pittsfield, Mass. We learn that the transmission specialists succeeded in stepping up the usual electric supply current to a potential of over one million volts, and in transmitting this enormous voltage a short distance These experiments mark a new era in electrical transmission, to be sure.

Our friends, the newspaper writers, have quite wisely given these experiments a prominent position and display in their news columns. Why not? A million volts is a figure to conjure with, both with the layman and with the serious electrical engineer. But if we may be pardoned for the criticism, we feel that our newspaper friends have been too hasty in judging the immediate worth of these experiments with relation to their bearing on transmission problems of today and tomorrow

Electric transmission, at least in its mathematical aspect, is a simple enough problem. We have three cardinal factors—voltage (or pressure), amperage (or rate of flow) and resistance of the line To transmit current, we must overcome a certain resistance of any line, no matter whether it is a thousand miles long or an inch long. The more voltage we apply, the more readily we overcome the line's resistance. And since the working ability of electricity depends on watts, the product of volts times amperes, it matters little whether we pass 100 amperes at ten volts or ten amperes at 100 volts. In either event we obtain 1000 watts. But from the standpoint of transmission, it is highly important whether we are handling a higher voltage and less amperes, or vice versa. The more amperes we pass through the line, the heavier the line must be so as not to offer too much resistance, and hence a heavy loss, to the transmitted current. An alternative is to increase the cross-sectional area of the conductor, but that means a vast increase in the cost of the line, especially over long distances.

So all the development in electrical transmission of power has been toward higher and still higher voltages, so that enormous volumes of electrical energy can be passed through lines made up of moderate sized conductors. Higher voltages call for better insulation, better transforming devices, and better switching gear Indeed, the electrical engineer has to assume a heavy burden with each additional increase in potential, so intricate are the insulation and manipulation phases of transmission.

The million-volt transmission experiments are still in the laboratory, let us not forget. In actual practice we are now about to open a 220,000-volt transmission line in southern California, which is a vast stride forward from those early days of long-distance electrical transmission back in 1891, when the first high-voltage line of 15,000 volts was inaugurated. And from 220,000 volts to 1,000,000 volts there is a still greater gap that must be bridged with no end of experimental work and engineering ideas and practical experience in the making of still better insulators, switching gear, transforming equipment and so on. Still, the experiments prove that one million volts can be handled with proper equipment, and that the day may come when we shall transmit electricity from the glaciers of Alaska to the gay lights of Broadway. But this will not be tomorrow, nor the next day; it may be several decades from now

Few men are better qualified to speak of this important subject of electric transmission than Dr Charles P. Steinmetz, Chief Consulting Engineer of the General Electric Company. Some time ago we asked Dr Steinmetz to write an article for the November issue of our new monthly SCIENTIFIC AMERICAN. This he has done, and it is particularly opportune at this time, when electrical transmission is a subject of such general discussion, that we should hear from a man who has seen the distribution of electricity grow from the 110-volt and 220-volt of the first Edison power plants to the 220,000-volt transmission lines of the Southern California Edison Company, and who, furthermore, has the vision to predict what we may look forward to with certainty in the future.

Deep Water to Long Island Sound

THE report of the Federal Commission which is investigating the question of further increase in channel depths in our leading seaport will be awaited with keen interest, not merely in this city and in its own hinterland, but in all the States which make use of the port of New York. We have frequently referred to the severe handicap to trade imposed by the undeveloped dock system and the antiquated methods of distribution by barge and lighter To these disadvantages must be added those arising from the lack of deep-water channels in various sections of the harbor

Work is under way, and has been for some years past, on this improvement. Some of it has been completed, notably that magnificent man-made waterway, the Ambrose Channel, two thousand feet in width and forty feet deep, which extends, unbroken, for seven miles from The Narrows to the Sea. Full forty feet of depth should be the ultimate aim in all the future work of deepening, that which is in progress and what is planned for the future. Newark Bay should have such a channel, and Jamaica Bay also, for at the rate this city is growing industrially, there will be a demand at both centers for channel accommodation for the largest freighters to lie at their docks. And the demand will come rather sooner than later, for such is the lesson of all transportation problems, whether for passenger or freight, whether by land or sea.

This port, by virtue of its geographical position, is today, and must ever remain, the chief port of entry and departure for that great stream of traffic which flows in ever-increasing volume (save in times of universal depression) between the Old and the New World, and between our republic and those of South America. The present era is the most important in the history of this port, for within the past few years there have been opened three waterways which will have a profound influence upon the growth of traffic at New York. In the order of importance these are the Panama Canal, the State Barge Canal and the Cape Cod Canal. The first undoubtedly places New York in a more favorable relation to the seaborne traffic of the world, the second will develop a broad belt of country rich in agriculture and industry, and will afford a more economical outlet for the traffic of the Great Lakes; the third should stimulate trade with the ports on our northern seaboard.

There is a final argument in favor of deepening the East River, which, from the Federal point of view, is perhaps the strongest of all. We refer to the fact that the leading navy yard of the United States is situated on the East River, and that, by providing forty feet of depth from the yard to the Sound, our ships will be in the unique position of having two deep-water approaches from the Sea, the entrances to which are over 100 miles apart. This means that a blockading fleet would have to be split in two, one-half being placed at each entrance, whereas we could attack with our whole strength at Montauk or at New York.

Electricity

Electrical Fixation of Nitrogen.—The usual electrical methods for the fixation of nitrogen are classed as follows. (1) The production of nitric acid and other nitrates by oxidation of atmospheric nitrogen in the electric arc; (2) the synthesis of ammonia from nitrogen and hydrogen through the action of a catalyst in an electrically heated furnace, (3) the high temperature production of the nitrides of certain metallic elements; (4) the production of cyanamides and cyanides. These methods are discussed in detail and figures are also given in a publication of the British Electrical and Allied Manufacturers' Association.

A Special Advantage of Electric Traction is the great certainty and economy with which time-table speeds can be worked to and lost time can be made up. With steam locomotives scheduled working is largely dependent on the quality of the coal, especially in hilly districts; while it is both difficult and costly to make up lost time. Owing to the great energy demanded by heavy trains, new regulations, particularly for mountain services, are often necessary in electrifications, in order to obtain a rational ratio peak load to average load, and care must be taken to prevent too many trains ascending gradients simultaneously

Largest Generator Built.—A 60,000 kva. 7000-volt, three-phase generator, rated at 1000 r p m, but designed to withstand 50 per cent increase in speed, has been completed by the Siemens-Schuckert Works in Germany, according to *Electrical World* The largest rating provided in any generator previously built by this company was 21,500 kva. so that this order represented a big jump beyond all experience The ability to withstand such overspeeding was also a severe requirement owing to the utter lack of high-grade nickel steel at the time the unit was ordered Owing to the size of the generator, special cars had to be built for the rotor and stator The rotor gondola car had two ten-wheel trucks.

The Trackless Trolley Abroad.—From a German periodical, *Elektrotechnische und Maschinenbau*, we learn that electrically-driven buses connect Vienna with a suburb a short distance away These trackless trolleys run on pneumatic tires and are fed from a double trolley line on which rolls a small contact-making carriage, connected with a flexible cable to the car The length of this cable can be varied, as its end is wound around a take-up drum. Approaching cars have to stop when passing each other, exchange their cables and proceed again. The cars are driven by two motors, built into the rear wheels. They are multipolar, slow-speed, direct current 550-volt motors, transmitting their power directly without any gears. The buses accommodate 24 passengers, but can carry as many as 40.

Steel Transmission Towers.—The increasing demands for electric power in every section of the world call for longer and higher transmission lines and greater voltages. The adoption of 110,000, 150,000, 166,000 and 220,000 volts as desirable for main transmission lines has introduced new problems in transmission tower steel. One important factor is ductility, combined with high elasticity, as the continued vibration in long spans caused by wind puts a heavy strain on the transmission towers. Crystallization is less likely to occur if the steel has great ductility and high elasticity One manufacturer of open hearth steel for transmission towers claims a minimum elongation of 22 per cent for his towers, an elastic limit of 45,000 pounds per square inch, and a bend of 180 degrees flat without cracking. Steel with these specifications has been found suitable for the record transmission lines of the West and will meet the requirements of any location.

Again, Electric Water Heaters.—There appears to be some misconception regarding the use of electricity for heating a water supply. Many persons, contemplating electricity for obtaining hot water supply, labor under the erroneous impression that such an installation calls for only a few amperes of current, and then only when the water is actually to be drawn. As a matter of fact the usual water heaters, which connect directly to the water pipe at the point where the water is to be drawn, require anywhere from 20 to 50 amperes. The all-faucet types, which serve to heat water for the entire plumbing system when wanted, draw anywhere from 50 to 70 amperes at 220 volts, and 80 amperes on 110 volts. It must be remembered, however, that these are instantaneous heaters, which means that an enormous localized heat is required. Where it is possible to heat a similar quantity of water, say in an hour or two, a relatively small amount of current would be required.

Science

Saved by Swollen Grain.—The steamer "Seapool" struck an iceberg off Newfoundland and began to fill The swelling of the grain in her forehold stopped the hole and prevented her from sinking

The Leaning Buddha is a Chinese rival of the tower of Pisa. This twelfth-century pagoda, near Nanking, is 100 feet high, of 13 stories, and inclines 12 feet from the perpendicular, while the 179-foot leaning tower of Pisa inclines 16½ feet.

A Statue of Herod the Great.—Excavations conducted by the British School of Archaeology have uncovered and identified the cloister around the famed court of Herod the Great, the magnificence of which was described by Josephus. These ruins of Ascalon reveal statues of the gods, and a gigantic statue of Herod the Great himself has just been found there

Tarred Roads Menace Fish Life.—The pink worms found in the mud-scrapings from country roads make excellent trout bait; but the carbolic acid from road tar kills them—and the trout too. Experiments prove that the spermatozoa of fish are destroyed by the carbolic acid from tar even when the quantity is so minute as to be almost undetectable.

New Use for Soda-Water Bottles.—One means employed in studying the growth and distribution of fishes is to set afloat both empty and weighted soda-water bottles to determine surface and bottom currents. In 1920 the Fishery Board of Scotland released 2400 bottles for this purpose and recovered, during the same year, 290 of them

How Elephants Play.—The Cape Colony elephant reserve, says the *Christian Science Monitor*, affords fine facilities for the observation of pachydermatous behavior The huge beasts often amuse themselves by squatting on their haunches at the top of a steep bank and coasting down to the pond at the bottom Baby elephants that evince fear are coaxed to the crown of the hill and shoved off

Humidity, the Misunderstood.—The layman uses the term "humidity" as a convenient summer cuss-word, even the scientist has no very exact way of determining the relative proportions of heat and moisture in the air We do know that a healthful percentage of humidity along our coasts is 50 to 75, a higher percentage benefits plant life but brings discomfort to man During high humidity electricity is stored by the atmosphere, and our body supply is depleted

The Home of Heads and Horns.—R. L. Ditmars, of the New York Zoological Park, is preparing a motion picture that puts the trick film into educational use It will show the construction of the new Museum Building that is to house the National Collection of Heads and Horns. The picture begins with the clearing of the forest, eight-second intervals represent a week's progress in building, and the end of the film will show the arrangement of specimens upon the walls.

Bear Island's History.—Midway between Norway and Spitzbergen, Bear Island thrusts its head, known as Mount Misery, above the cold waters. The whole island, save for moss and lichens, is almost destitute of vegetation Long ago it was joined with the Spitzbergen archipelago, the continental shelf upon which the island sits shows a drowned valley deepening to 200 fathoms; this marks the course of an ancient river system that must have drained an area larger than the present basin of the Volga.

Concerning the Late John Daniel.—Experts of the American Museum of Natural History are studying the remains of "John Daniel," the gorilla that died while with Ringling Brothers. Body and brain are being dissected by specialists, casts of the head and face have been made, "finger prints" have been taken, and interesting facts pointing to "John" as a distant relative of man have already been disclosed Later the public will no doubt see him, life-like but motionless, in the hall of primates of the Museum.

Finger Prints and Old Masters.—Two canvases entitled "The Virgin of the Rocks," one in the Louvre, the other in the National Gallery, London, have been attributed to Leonardo da Vinci Scotland Yard was called in to decide the vexed question of authorship Leonardo, like Titian, used his fingers freely in laying on paint—flesh and glazings are particularly amenable to this method; under a good glass the whorls of finger and thumb were well-defined on both canvases, and were found to be identical on both. This is a triumph for those critics who declared both canvases to be the work of Leonardo, and a corresponding defeat to those holding that the London replica, while it might have been executed in his studio, was the work of a pupil.

Astronomy

Origin of Lunar Features.—Mr Walter Goodacre, discussing the photographs of the moon taken at Mount Wilson with the Hooker telescope, says that the hypothesis ascribing the formation of lunar craters to the impact of meteors is now generally discredited, but if additional arguments against it were necessary they would be found in a careful study of the superb photographs above mentioned He states that a consideration of the fine detail found in these pictures, especially in relation to the many crater chains and clefts, suggests that their existence can only be accounted for on the supposition that they are due to volcanic agency in the early days of the moon's history

What Is a "New" Star?—Dr Harlow Shapley, writing of novæ and variable stars, points out that at least two objects appear to be entitled to the name "new star" in a literal sense These are stars which have increased in brightness from the unknown and do not fade away One of them, RT Serpentis, has been of magnitude 11 for the last seven years, first appearing in 1909 as a star of magnitude 14 The other is 27, 1920, which, according to Wolf, appeared in 1908 and had reached the 11th magnitude in 1920 Eventually these two stars may fade away, or they may be stars slowly emerging from behind obscuring clouds, rather than objects newly born Up to the present time, however, the name "new star" is more appropriate for them than for ordinary "novæ," so called

Mt. Wilson Lunar Photographs.—The last report of the moon section of the British Astronomical Association dwells upon the many additions that have been made to the map of the moon by recent photographs taken with the great 100-inch reflector at Mount Wilson and suggests that a complete photographic atlas of the moon made by the same instrument would be a magnificent achievement. For example, one of the Mt. Wilson photographs depicts the whole of the Mare Imbrium A rough count of the craters and craterlets shown in this region gives a total of more than 700, of which about 300 are not found on any existing maps. It would take an observer, using a powerful telescope, several years to detect and map all of these minute details, which have been recorded by the camera in less than two seconds!

A Great Catalogue of Double Stars.—As previously announced in this column, Dr Robert G Aitken is carrying out the work left unfinished by the late Professor Doolittle of bringing Burnham's "General Catalogue of Double Stars" up to date The original work, at the time of its publication in 1906, was a practically complete record of every known double star within 121 degrees of the north pole of the sky The discovery and measurement of doubles has made great progress since that time The new work will contain records of some 20,000 stars and will not be ready for the printer for at least three years Meanwhile, Dr Aitken is in a position to offer lists of stars specially worth remeasuring to any observers who wish to cooperate in making the catalogue as valuable as possible

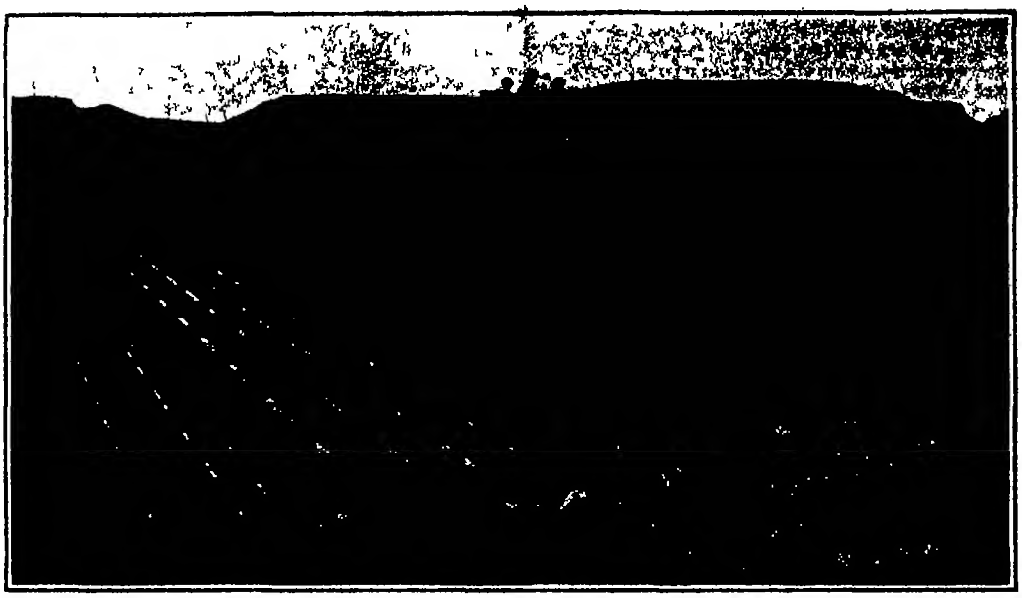
A Novelty in Astronomical Publications is a circular of the Observatory of Cracow, mentioned in the *Journal of the B.A A* The language of the circular, "*latino sine flexione*," was devised by Prof G Peano, of Turin, on lines suggested by Leibnitz. The words are mostly Latin, without grammatical inflection, and the whole can be easily read by anybody with an ordinary school knowledge of Latin and a smattering of French Here is a specimen sentence "*Observatorios et astronomos, qui non mitte etiam ad nos suo publicationes, es precato to pone Observatorio Astronomico de Cracovia (Polonia) in lista de correspondentes*" Meaning "Observatories and astronomers who do not at present send us their publications, are asked to place the *Astronomical Observatory of Cracow* (Poland) on their list of exchanges."

A Star Larger Than Betelgeuse.—The enormous size of Betelgeuse, as revealed by interferometer measurements at Mount Wilson, was a topic of widespread popular interest a few months ago. News now comes from the same observatory that Antares, the well-known first magnitude star in the Scorpion, is probably even bigger Its angular diameter, as measured with the interferometer, comes out 0.040 second, thus greatly exceeding Russell's predicted value of 0.028 second. There is some question as to the parallax. If it is assumed that Antares belongs to the Scorpion group, the resulting value of the parallax is 0 0085 sec, and the diameter 430,000,000 miles. If, however, we give the same weight to this value and to the mean of the measured parallaxes, we find 0 018 sec, and a diameter of 280,000,000 miles. Either value is greater than that obtained for Betelgeuse, viz., 218,000,000 miles.

Death Valley Transportation

How the Borax is Transported from This Hottest of Regions to the Nearest Rail Connection

By John L. Von Blon



Automobile equipped with flanged wheels in daily operation, carrying mail and passengers, over the 20 miles of the Death Valley Railroad, between Ryan and the borax mines

UNIQUE in the beginning long ago, and so remaining to the present, transportation methods in Death Valley yet have undergone the processes of a most interesting evolution. This statement applies more particularly to the changes wrought in the hauling of the output of the forbidding California sink's one great industry—borax production. Fifty, forty and as recent as twenty years since, the means of transport to the world without—for Death Valley was an infernal region apart—consisted of the "twenty mule" teams that brought fame to themselves and the mysterious desert pit. The full story of the romance and the tragedy that attended these indomitable commercial caravans through the hottest spot on the globe never can be written. Swirling sands blotted it out from day to day. But these simple carriers made good. The creaking wagons and the plodding mules proved themselves extraordinarily efficient in making delivery many weary miles over burning alkali waste to the nearest rail shipping point, and aided materially in the making of a world civilization. If "cleanliness is next to godliness" they were a boon to humanity, for the cleansing agency they made available polished more than one continent. Still, the hardships, the downright misery suffered by beasts and drivers are beyond the comprehension of dwellers in blessed places of brooks and shade and tempered breezes. As a rule the animals lasted but a short time. A large proportion of the teamsters, however once inured to the life, jogged forth and back through the blinding white dust for years and years, and for most of them it became a shroud after the race was run. To live in the weird silence, gray and sombre, between the Funeral Range and the Panamints is to die there. The "desert rat" does not leave because he cannot be content elsewhere. A few of the old time drivers survive. The climate has the virtue of being exceedingly healthful for those who can stand it.

The tugging strings of mule flesh drew their unwieldy loads on wretched trails, ever changing—the deep gashes cut in hideous hills by cloudburst, the rough wash and the treacherous salt marsh, where bottom is an uncertainty. In one place more than thirty years ago an eight mile stretch of road six feet wide was built across a solid reach of salt and graded exclusively with sledge hammers. The action of heat and moisture from below had forced up salt pinnacles hard as rock, two or three feet high and countless, and these had to be hammered down. This road is unlike any other. It facilitated hauling but it was cruel to hoofs. Sloping down to this salt artery are several wide fields of crude borax—borate of soda. The main and better deposits are higher up, which was a factor of consequence to the four-legged "locomotives." The "team" consisted of sixteen to twenty-two animals, dependent upon season and conditions. The leaders, it will be observed by reference to the illustration, were horses. This was because these proved steadier and more intelligent in responding to the directions jerked from the driver's seat at the rear of the long dust laden column.

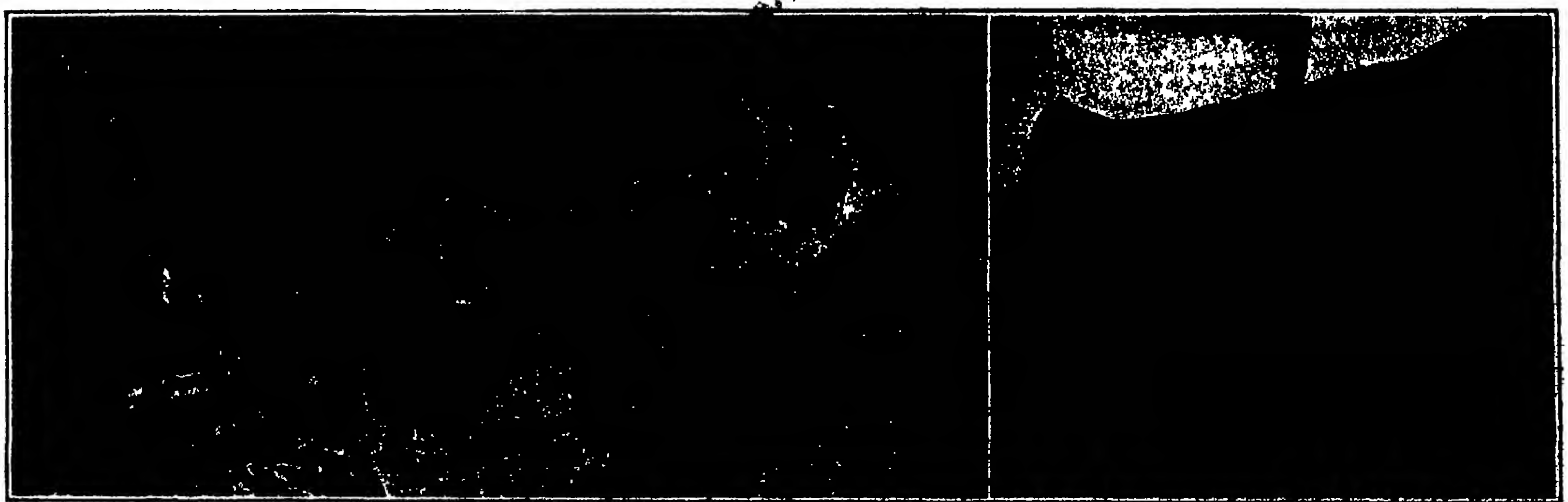
When progress demanded more expeditious service mules were superseded by steam, a slow but sure heavy tractor of the upright type drawing laden trailers to railhead. The Piute Indians, Arabs of Inyo, called this contrivance "fire devil" and for months they wouldn't venture within a hundred yards of the smoking, hissing monster. In the more torrid season the crews suffered terribly, and a man on one of the wagons died with a canteen of water in his hand. The accompanying photograph was taken in the winter, when ice frequently forms. In front of the boiler a cold water tank was ingeniously anchored on the tractor. The water in it never was long cold. In a few hours it would become so heated from the sun's intense rays that it had to be uncovered. Frequently it was pumped into the boiler practically at the steam-producing stage. Here probably is the one spot on the globe where it would be possible to install a steam-power plant and operate it with little artificial heat. The temperature is furnace-like. Death Valley's maximum of 160 degrees Fahrenheit never has been equalled elsewhere. In the summer 140 is common, and at midnight the mercury hovers at 120. So hot does the earth become in August that a rock or a bit of iron scorches the naked hand like a live coal. No wonder water boils in the sun! There was nothing pleasant about handling that tractor.

Now the Death Valley railroad, itself a borax enterprise, reaches outside connections with mineral trains, linking the principal mines with the station of Ryan. This is a trackage of twenty miles and here again an unusual vehicle is in operation. This is an old automobile equipped with flanged wheels and it carries the mail daily between the two points, handling also occasional passengers and making surprisingly good time. Because of frequent violent gales, hot as blasts of flame, a stop is out of the question but riding is made tolerable by speeding up. Sometimes on a trestle a whiff of cool air is encountered. Occasionally the machine is blown off the rails.

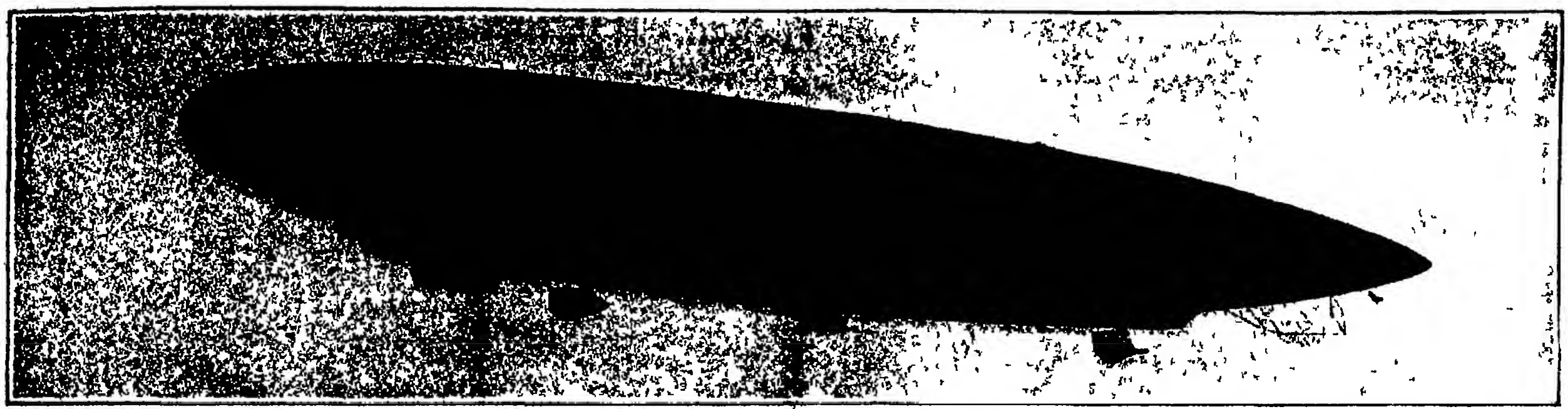
At the mines, where the landscape ever looks like a snowfield but doesn't feel at all that way, gasoline motors are employed for borax and other hauling.

The Temperature at Which Fish Thrive

EXPERIMENTS recently made abroad by M. P. Audigé as to the temperature best suited to fish, show that this varies markedly according to the nature of the fish. In the case of those fish which are classified as eurythermic when subjected to a constant temperature of 14 or 15 deg. Cent., they do not grow as well as the parent fish which have been subjected to the ordinary seasonal variations of temperature. But when the offspring are kept at a constant temperature of 20 or 21 deg. Cent., on the other hand, they grow much faster, and faster still at 24 or 25 deg. Cent., so that by the time they have reached their fourth year they are twice as large as fish living naturally.



Left: The famous "twenty-mule" team of twenty years ago. *Right:* This steam tractor train superseded the mule wagons. Note the improvised water tank ingeniously anchored in front of the boiler



General view of the German non-rigid Parseval type airship "PL-27" in actual flight. Capacity: 1,000,000 cu ft. Length: 518 feet. Diameter: 64.3 feet. Useful load: 39,600 pounds. Total horsepower: 966. Speed, 72 miles per hour

Getting a Line on the Higher Atmospheres

By S. R. Winters

WHEN Prof R H Goddard of Clark University details his exploring rocket on its extreme sky-climbing errand—probably in the vicinity of the moon—a weather-recording device recently designed by S F Fergusson, meteorologist of the United States Weather Bureau, may serve as a companion instrument in revealing atmospheric conditions at excessive altitudes. The new meteorograph—weighing approximately six ounces—is the lightest apparatus of the kind ever built With its protecting basket and a parachute, ready for ascension, the weather-recorder weighs slightly more than nine ounces, while a meteorograph designed by a Frenchman in 1904—heretofore a claimant for the distinction of extreme lightness—weighs about two pounds, including the basket and parachute

The Fergusson invention, although having features which recommend it as a possible companion instrument of the Goddard exploring rocket, is of primary service as an accompaniment of balloons for faithfully registering by an intelligible method temperature, moisture, pressure, and wind velocity miles above the earth's surface Heretofore the excessive cost of the rubber balloons employed in carrying aloft the heavier type of weather-recording instruments has factored in its use as an ally in weather prophecy—obviously, a limiting factor The new aerological apparatus can be lifted by one or two small pilot balloons, the cost of these being barely one-tenth as much as the balloons now detailed for exploration of the upper atmosphere. Then, too, if we are to accept an authoritative claim, the pilot balloon is of superior quality, a virtue, when coupled with the light meteorograph, vouchsafing the attainment of greater heights for information upon which to base the forecast, "Fair and Warmer Tomorrow"

The Fergusson progeny, which has qualified for service by rigid laboratory tests, aims to overcome weaknesses inherent in its predecessors. The defects of previous designs are thus summarized The instruments are complex, the parts are hand-made and do not lend themselves to repair in the absence of a skilled instrument maker and are not adapted to quantity production, the fixedness of the supports is ordinarily secured by use of thick base plates and bases attached to a pivoted device, thus not insuring permanency, the commercial clocks used operate 30 hours at a single winding, and the time-drum rotates once in an hour—an inharmonious arrangement inasmuch as an ascension seldom requires more than three hours—indicating that a portion of the records is frequently obscured or lost because of tracings of surface conditions after the instrument descends and before the clock suspends operation, the number of operations entailed when the device is prepared for flight in measuring and reading the records is unnecessarily large.

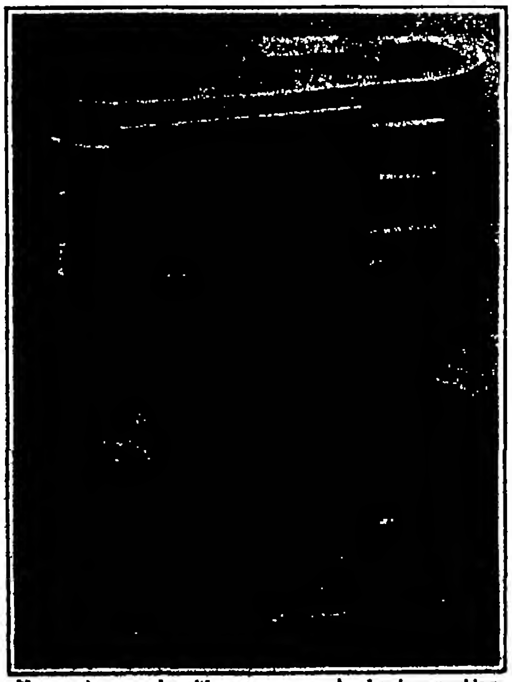
The clock, the heaviest integral part of a light weather-recording instrument, was subjected to modifications in the interest of lightness and cheapness of production. The movement employed, a massed formation of parts selected from a series of American clocks, partakes of the general character of the Ingersoll Watch. The improvised unit is stronger, however, and the teeth of the pinions are severed. The quality of the clockwork is more variable than desired, but the movement is a reliable timekeeper and can be employed economically. The fault of other instruments in tracing surface conditions after the meteorograph has returned to earth has been remedied in the recent design. The clock has its main spring on the center staff, or minute-hand arbor, to which the time drum is clamped Here a tiny watch spring is of sufficient power, and the number of rotations of the drum (less than seven) can be restricted as desired by winding the spring the requisite number of turns.

The temperature element, or the mechanism for charting the degree of heat or cold, is described as extremely sensitive and more powerful than record strips incorporated in similar instruments The strip of "thermostatic metal"—made of closely-embracing sheets of invar and bronze—is only 0.2 of a millimeter (one millimeter is about .04 of an inch) thick

The outstanding feature of the barographic portion of the weather recorder is its variable scale, whereby minor changes of pressure at altitudes above 32,800 feet—exceeding the air soaring record of Major R W Schroeder of the United States Army Air Service—can be read with greater accuracy than is possible with a uniform scale The ratio of the scale of a barograph to that of the mercurial barometer is 1 to 10, that is, one millimeter of movement of the pen of a barograph at sea level is equal to a pressure change represented by ten millimeters of mercury But the record sheets of the barograph cannot be relied upon within 1 millimeter of space traversed, and thus, in the reading of heights exceeding 30,000 meters, an error in excess of 2000 meters may occur The variable scale of the new meteorograph, according to the claims of the designer, eliminates this source of error

The humidity element consists of six or eight strands, each composed of three fine hairs—these being sheltered from the heat of the sun The tension of these hair-like strands is maintained by a flat spring, the outer

(Continued on page 243)



New meteorograph with cover removed, showing working mechanism. The clock-driven drum at left may be lifted out through top of cover, while the marking pointers, pivoted and actuated at the right, are accessible through the sliding door on the side

Meteorograph developed by the Bureau of Standards

The Parseval Semi-Rigid Airship "PL-27"

By Ralph Howard

THE development of the German non rigid PL airships occurred between 1906 and 1917 These two letters stand for "Parseval Luftschiff" The Parseval airships are all built according to the patents of Major August von Parseval, Dr Engineer by the Luft Fahrzeug Gesellschaft (L.F.G.) at Berlin and Bitterfeld That the Parseval airships were successful is attested by the fact that they were used before the war in Austria, England, Italy, Russia and Japan.

Since 1913 all Parseval airships were constructed with envelopes having the Parseval patent trajectory band system of car suspension, which is a very efficient system of non-rigid construction The "PL-27," built during 1916, is in reality a semi non rigid airship, although classified in Germany as a non rigid one Within the envelope of this ship there is a V shaped keel extending almost the entire length of the aircraft and containing the narrow runway or "catswalk" common to all large airships of the Zeppelin or rigid type Forward, beneath this, is the navigating car or gondola, while immediately behind it is the first power car in a central position In the center of the dirigible, on each side of the keel, are two power "eggs" or cars similar to those used on the later types of Zeppelins At almost the extreme aft end of the keel is located another power car All of the power cars are carefully streamlined The gasoline tanks and water ballast bags are located on each side of the runway, the same as in rigid airships "PL 27" is the largest "semi non rigid" airship built to date, and her performances have been extremely good, especially as regards useful load and speed Nothing has heretofore been published about the carefully guarded development of this type of ship that took place in Germany during the late war

The interesting and important main dimensions, weights, performances, etc, are as follows

Capacity, 1,000,000 cubic feet length over all, 518 feet diameter, 64.3 feet total load, 74 700 pounds, useful load, 30,000 pounds number of engines, 4, make of engines, Maybach, total horsepower 900, propellers 4 two-bladed of wood speed 72 miles per hour

The photograph gives an idea of the complexity of a non-rigid airship of such dimensions It has the advantage, however, of not being so liable to break its back, or certain girders thereof, as happened in the case of the "ZR 2," with such unfortunate results If, instead of prohibiting experimentation of any sort with airships by Germany in the Versailles Treaty, the United States had allowed construction and experiments to continue to a certain limited extent, she would undoubtedly have benefited thereby in her new policy of aircraft construction, as proper tests of "PL-27" would probably show her to be superior to the Zeppelins as regards economy and useful weight lifted, although at present the latter type of airship is considered in Germany to be better for long-distance transportation

The above photograph, at first glance, might be taken for one of a Zeppelin Close study reveals the points of difference, however

Curing Leprosy with Antimony

IT is reported by a British investigator, Mr F G Cawston, who has been studying leprosy at Durban, that the administration of colloidal antimony appears to produce good effects According to the *British Medical Journal* he found that lepers in an advanced state of the disease, with all of their fingers and toes suppurating, were helped to such an extent by this treatment that the suppuration entirely ceased.

Needed—A New Army Uniform

An Argument and a Suggestion Regarding a Change in Our Doughboy's Outfit

By E C Crossman

FROM the physiological effect the uniform must have been designed by some person interested in seeing what constant coddling of the chest and throat would do to the human race Normally the chest is hot and perspiring in this sort of a coat Not only is the coat buttoned to the top of the chest but there is a standing collar further to prevent the entrance of any air To throw the coat open after wearing it a while is to test the resistance of the subject to sudden chilling and colds

In hot weather the Army coat is a beautifully adapted sweat box If you then seize the unfortunate military person in a firm grasp and wrap his nether limbs in leather leggins or those of the cloth wind around variety so that no air can possibly strike his ankles and aid in keeping the body temperature down you have a combination that cannot be surpassed for gilt-edged asininity

Covering up the chest and throat in all sorts of weather does not protect the wearer It merely encourages troubles of the chest and lungs Physicians assure us that with their lighter clothing women take cold less easily than the men are less subject to pneumonia and other pulmonary troubles and in general tweak old Boreas's whiskers and suffer but little for their contempt

Now that war is recognized to be a gigantic wasteful inefficient crude gory and engineering job romantic as digging a canal and with the means for your taking off probably developed in a chemical laboratory instead of being the flashing sword this uniform nonsense is about played out It has no place in modern warfare except to distinguish those of one side from those of the other and to show who are active fighting men and who are not

War is a job of mighty hard work nine parts walking to one of fighting a hundred parts carrying things to one part shooting A brass band and pretty ribbons and a choker collar and a flat back and a pair of boots with spurs on them have as much to do with the grim job of digging a trench and then clambering out of it later to the rattling of engineering tools called machine guns as they have to do with an air lock under the Hudson River

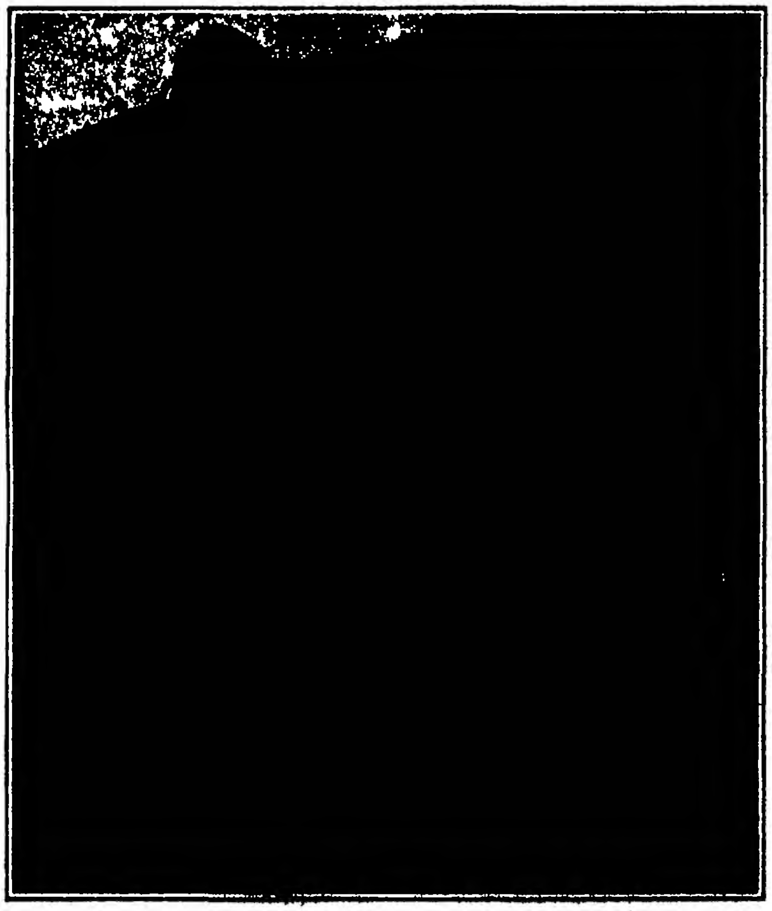
Our present examples of uniforms don t even possess the merit of neatness as worn by the enlisted men The cloth used is something like the stuff of which Teddy Bears are made a nice woolly material that defies any attempt to make it lie in smooth surfaces The collars fit just about as often as you would expect a collar to fit when you picked one out by the soldier s chest measurement or his foot measurement or some other extraneous consideration They are a dejected sort of a collar too and don t stand up like the collar of the officer s blouse or coat The type of coat with stand up collar emphasizes any lack of fit which the lapel type of coat might conceal and all in all the average enlisted man of the present army in spite of the pathetic attempt at a military effect of his coat, looks more like a misfit than a soldier or the self respecting youth that he is

Here and there some more than usually self respecting chap rebels and spends his hard earned cash in a made-to-order uniform of serge This done being still sensible when there is neither M P nor officer around he unbuttons his coat and gives his chest a chance for a nice long breath so the effect of the high Prussian stiff necked chin-chucking, enemy scaring collar is largely lost On a hot day which is not unusual on this North American continent in the summer time the only chance the soldier has to be comfortable with the present coat is to do without it The British abandoned their stiff necked uniform years ago—and they are alleged to be a people slow to move If so then our own retention of the Prussian uniform may be easily characterized—it is slower than slow

Two advantages are urged for the present American army blouse and both are futile ones One of them is that it is typically American and lets the American and the British soldier be told apart The other, with a grain more sense to it is that in cold and inclement weather in actual fighting the American coat better protects chest and neck The British are said to have had to issue mufflers in France

The reply to the first is that this country is not at present so over run with British troops that there is likely to be much confusion To the second argument the reply is just as easy Any tailor can design a coat with lapels to turn up and button across, which would afford all the protection in the event of going into action during cold weather now given by the American type of blouse

The present uniform has additional pieces of cloth sewed on here and there the top left unsewed and fastened with a button These patches are dignified by the term pocket. They were copied after the British with the minor difference that the British pocket is a pocket and is made to carry things. It is the difference between a real street and one painted on the back drop. They look the same but one of them is for show alone



All the comforts of home! Note the soldier on the right, and the one on the left. The chap on the left merely has his blouse collar folded down, if it were made that way it would look better than the other

What is urgently needed therefore, are these few things

1 A coat cut with turn-down lapels after the fashion of the British blouse to permit air to reach and leave the chest regions, and to afford the neck free and uncramped movement.

2 Pockets made with some form of pleats or bellows which would permit if necessary, some few personal accessories to be carried without putting humps and bulges all over the son of Mars form.

3 Long trousers as articles of regular issue, not special, with the abominable leggin and its leg swathing, sweating varicose-vein producing pressure and the knee cutting tight breeches, used only for field work, and left off when this kind of activity is over

A change in the color of the uniform is urgently needed for more than one reason Now that the war is over and surplus stocks have leaked out through sales to private stores, and every discharged soldier took home and kept his uniform we find it, either in full or in part, on truck drivers, garbage collectors, chauffeurs elevator men and beggars. The very color is an abomination to a weary people Futile and emasculated and quite obviously unenforceable laws have been passed by legislatures and Congress, and passed just as promptly into innocuous desuetude those providing for dire penalties for mis use of the uniform or parts thereof The country is full of nut-brown shirts, pants and even coats to which the wearers have good title and cannot be deprived of

The color itself is most hideous and inferior to others for war The Marine Corps have a far better color for concealment in the field a darker brown with a green tinge to it. Tried in various lights and against various backgrounds it has proved superior to the Army shade just as did the green gray of the German The Army shade is no shade, the uniform ranges from a dirty mustard through every variation of brown or tan known to chemistry, and some impossible to reproduce

Wherefore with gentle peace descended over the scene with Congress having taken one good swing at the Army and chopped it from 280 000 to 150,000 and just getting its second wind, it is now a fine time to detail a few hundred officers on the job of considering a sane and sensible uniform in cut and color for that aggregation of engineer specialists we keep on hand under the name of Regular Army When their purpose is analyzed and the realization is reached that they are merely to engage in hard dirty unromantic engineer operations leading to destruction of an opposing body of men also thus engaged by the use of modern scientific apparatus, then will the old notion of military pomp be dropped and a uniform considered with the cold, critical eye of efficiency

Utility of Reatomizing Devices

THE grade of gasoline sold today is extremely difficult to vaporize completely and even when the vapor has been made it is easily condensed by striking obstacles to its free passage. The butterfly valve used in all carburetors, when only partly opened presents such an obstacle. As the vapor strikes this butterfly valve the larger portion of it is condensed and thrown against one wall of the carburetor and some passes up the wall of the manifold in a liquid form and cannot be equally divided between the various cylinders.

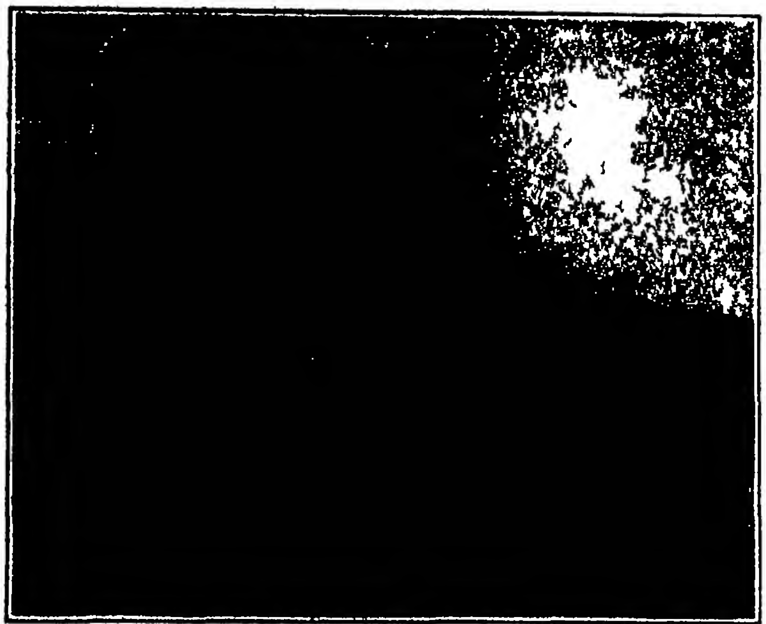
To meet this a well known carburetor manufacturer announces a "reatomizer," a device recently invented by F O. Ball, which is placed between the carburetor and the manifold. It comprises a spacer into which is pressed a venturi throat carrying four small tubes. The spacer contains a passageway of the same diameter as the intake manifold. Around the lower outside edge of the reatomizer is a groove or annulus which forms a small circular chamber between the inside of the spacer and the outside of the reatomizer. The ejector effect of air flowing past a tube extending into the air stream in the direction of flow of air is very well known. This principle is the basic idea of this reatomizer. The ejector effect on the four tubes which extend into the throat tends to draw into the annulus any liquid gasoline which may be passing up the wall of the carburetor and to eject it from the tubes in an atomized condition so that it floats in the air stream and goes equally to the different cylinders.

It is claimed that this simple but sure reatomization of the gasoline makes it possible to adjust the carburetor for a much leaner mixture, thus lowering the fuel consumption and reducing crankcase dilution.

Paper Molds for Concrete Test Blocks

WEIGHING only seven ounces, collapsible and portable, a paper mold for concrete test cylinders, as designed by the National Bureau of Standards, offers the novel advantages of being slit lengthwise and capable of being assembled at the job by lacing-up with a stapling machine. Its make-up permits nesting during shipment. Testing concrete in construction work and linking these tests with laboratory experiments and control is a problem confronting the engineer who may supervise the designing of concrete ships, buildings and roads

The portable paper mold is a contribution that may assist in solving the problem, because of its simplicity and absence of bulk compared with the steel mold which weighs about 22 pounds The mold is made of heavily water-proofed cardboard, and when nested for shipment 25 cylinders occupy slightly more bulk and weigh only half as much as one steel mold used in laboratory work. Twenty five one-half-inch staples, situated at intervals of one-half inch, are employed in lacing the container along the slit. The stapling machine weighs less than five pounds.



Portable paper molds, from which concrete blocks for test may be made at any time "on the job"

Once used, paper molds are worthless, except when left on the cylinder as a protecting influence to the concrete in transit to the laboratory Comparative tests with steel and paper molds failed to reveal any deterioration of strength by the use of the latter There is an absence of paper caps for base and tops, a layer of cement paste in the bottom of the mold before pouring the concrete and another layer on top preserve the concrete from loss of water and dryness Likewise these cement caps answer the purpose of supplying adequate bedding surfaces during the compression tests, provided they are ground smooth on a flat steel plate, sprinkled with carborundum The Emergency Fleet Corporation of the United States Shipping Board use these paper molds in testing the product used in the pouring of concrete ships and barges.—By *S R. Winters*

How Moisture Content and Storage Affect the Strength of Boxes

OF two boxes made exactly alike from the same grade and thickness of lumber, one may stand ten times as much rough handling as the other, because of a difference in the moisture content of the lumber or a difference in subsequent conditions. Tests made at the Forest Products Laboratory Madison, Wis, show that only when a box is to be used for a very short time immediately after manufacture is the proper seasoning of the lumber unimportant.

Within a week after manufacture a box made of green lumber suffers a marked reduction in strength As the wood dries the nails lose their grip The fibers which are bent down along the nail shrink away from it in the direction of the end grain the direction in which it was most firmly held, leaving the nail held only by two sides Under such circumstances the weaving action during transportation alone will readily cause the nails to work loose and even come out of the box Boxes made of green lumber at the laboratory and kept for a year in dry storage tested only about one-sixth as strong as similarly made boxes tested at the time of manufacture

If a box is made of dry wood and then subjected to alternate wettings and dryings through cold storage or exposure to weather the nails will be loosened just the same as in green lumber Boxes made up from dry lumber were kept for two weeks in damp storage and then for two weeks in dry storage After this treatment the boxes withstood only one-tenth as much rough handling as those made of air dry lumber

A box made of lumber in the proper moisture condition will stand ordinary storage without any appreciable loss in the holding power of the nails The best results are, therefore obtained when the lumber is seasoned in accordance with the atmospheric conditions which the box will encounter in service If it is impossible to forecast conditions, it is advisable to use air-dry lumber containing 12 to 15 per cent moisture

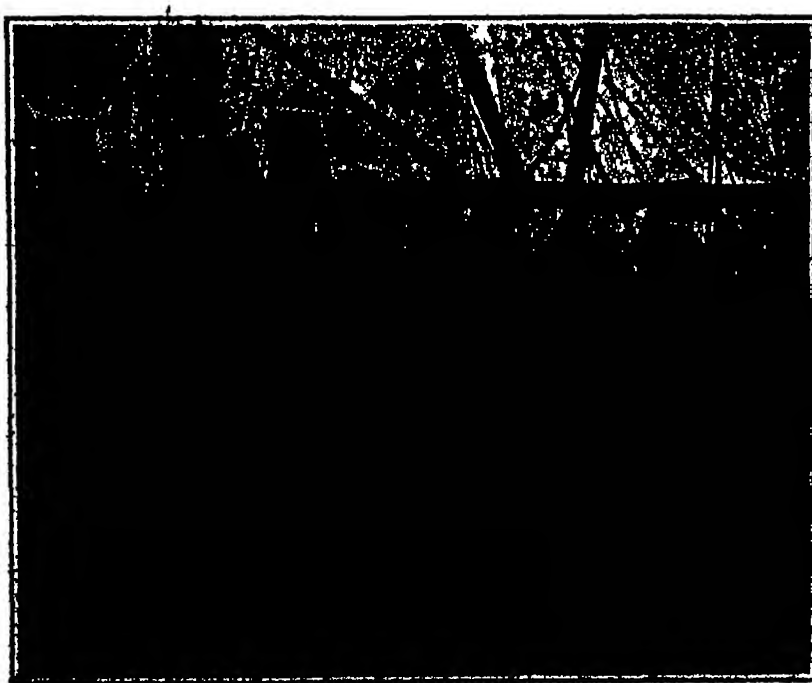
Package Conveyor for Loading and Unloading Ships

A GREAT deal of attention has been paid to loading and unloading machines for handling materials in large bulk, such as coal ore grain etc, and the machinery for performing this work has been developed to a high state of efficiency but hitherto not very much has been done to expedite the work of handling cargoes of small boxes or packages

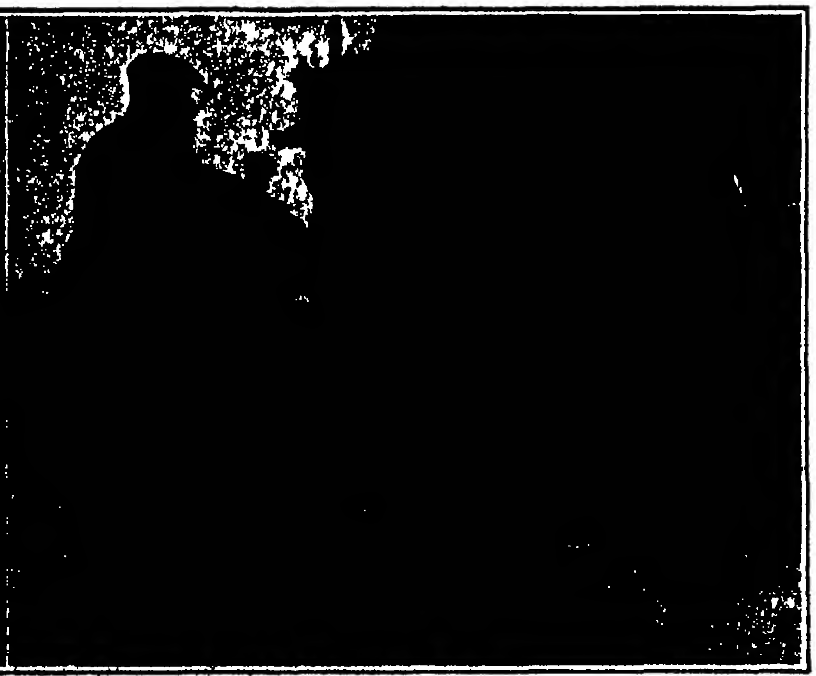
An ingenious canvas belt conveyor for this purpose is illustrated herewith It is adapted to convey small boxes and packages of all shapes from the dock to the hold of the ship and vice versa. The conveyor consists primarily of a bridge or truss mounted on rollers so that it may be readily moved across the deck of the vessel with one end overhanging the dock There are two parallel endless chains which are run over pulleys on the truss. At intervals the two chains are connected by means of bars or rungs A canvas belt is attached to the rungs with enough slack between successive rungs to form pockets in which the material to be conveyed may be supported At the outboard end of the truss the chains turn at right angles and are kept taut in this position by means of a carriage which hangs close to the floor of the dock The chains may be adjusted for vessels of different height and for variations of the tide Our illustrations show the machine in the act of unloading boxes from the ship As the boxes come along in the canvas pockets, they are carried down off the end of the truss and enter a frame which is shown to better advantage in the picture on the right hand side Here they are automatically tipped out so that they may readily be seized by dock hands and placed on a roller platform along which they are pushed to the point of delivery

Further News About Static Electricity

AN Italian engineer Mr G Lentner is stated in a recent number of the *Bibliothèque Universelle* Lausanne Switzerland to have succeeded in utilizing atmospheric potential in the following manner A post about 12 m in height (and forming a sort of antenna) is erected This post ends in a collector consisting of an aluminum sphere provided with points covered with radioactive substances This collector communicates by a conducting wire with a special transformer Under these conditions the earth current and atmospheric current attract each other through reciprocal induction The radioactive substances exert an influence upon the transformer whose nature is not yet understood At any rate the results are said to be very encouraging so that the inventor expects to repeat his experiments upon a larger scale



Canvas conveyor for loading and unloading ships



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Enlarged view of the point where the conveyor delivers the boxes

Succeeding in Scientific Research

Opportunities for the Young Technicist in a Relatively Virgin Field of Endeavor

By Raymond Francis Yates

THE scientific research laboratory is today a very important part of every large industrial establishment. In fact, large industries cannot afford to be without research facilities and a highly trained staff of workers. The past twenty-five years have brought about very important and revolutionary changes in this respect. A tremendous field has been opened up for the imaginative, scientifically trained worker. Every day problems are solved behind the closed doors of the laboratory that will effect the destiny of mankind.

Dr. W. R. Whitney, Director of Research in the great laboratories of the General Electric Company, was kind enough to assist the writer in the preparation of this manuscript which is addressed to young men who believe they have some aptitude along this line of human endeavor. Dr. Whitney is certainly well qualified to give advice to young men who are interested in research work. The broadness of his experience and his unquestionable success in the direction of some of the most important researches that have ever been made enables him to impart advice that few men in the world are able to give.

No field of human endeavor is more fascinating than scientific research. There is more romance and adventure in a scientific laboratory than there is in the unexplored wilds of the Amazon. It is simply a different kind of exploration with a far greater chance of making a discovery. The research worker is always laboring on the borderline of the unknown, he is always confronted with mystery. At any moment he may make a discovery, just as the explorer in unknown lands may brush aside the bushes on a hill top or mountain side and gaze out over a new lake with gold-speckled shores glistening in the blistering sunlight. There is a peculiar lure in research—a subtle expectancy that may at any moment be satisfied with realization. This striking off into the depths of the unknown causes the blood to tingle and fills one's life with an insatiable desire to penetrate the blackness of the unknown.

When the writer asked Dr. Whitney what he thought the ambition of a research worker ought to be, he answered, "He should appreciate infinite possibilities." This is indeed a significant statement and one that should greatly interest a young man who contemplates entering this field. A man who realizes the infinite possibilities of research is in a good frame of mind to accomplish something. This is wholesome advice.

The average Research Engineer may command a salary of from three to five thousand dollars per year. There is no definite salary limit for a man of exceptional ability. Charles P. Steinmetz is a Research Engineer who is paid an enormously high salary and he is one of the foremost scientific investigators of this country. To say the least, the field of industrial and scientific research will give any conscientious worker a good livelihood.

When Dr. Whitney was asked if a man could succeed in Research Engineering without attending college he answered in the affirmative. A very complete training is necessary however, and the foundation of this training will be based on mathematics. The trained research worker, unless he is of the highly imaginative type, must have a good mathematical foundation to work with. Of course this knowledge can be obtained outside of college as well as the other scientific knowledge which the worker will have to assimilate. A man struggling to succeed in this field without taking advantage of the college curriculum should associate himself with a trained research worker in an industrial laboratory. The inspiration and help to be obtained in this way are of utmost value to say nothing of the advantage of working in a scientific atmosphere. Michael Farraday's association with Sir Humphrey Davy illustrates this point very effectively.

The demand for research engineers will always be with us. Today the demand is limited by the supply. There is a pressing need for highly trained imaginative workers in industrial research laboratories. It is only during the past twenty-five years that the research laboratory has been given a place of importance in industry and what development the next twenty-five years will bring is difficult to foresee. That the development will be extensive there is no doubt. The extension of human knowledge through the application of the industrial research laboratory is in its infancy. The future of no field of human endeavor could hold more promise than that of Research Engineering.

Dr. Whitney believes that a man should take a post graduate course of two years and a college course of four years if he desires to enter the profession as a first-rate research worker provided with all essentials for rapid development and success. This extensive college training will have to be supplemented with two or three years additional experience working with men who are trained in actual research methods. The research worker is not merely a cold storage for facts, he must also be able to manipulate and construct apparatus for special work. He has much to learn after he leaves college and he can only gain this by actual contact with problems and through association with men who have been "through the mill." Knowledge does not find its way to the finger tips without experience and very little experience of this nature is given in the colleges.

Research Engineering is a very broad field. It has to do with every phase of science. It is a field for the specialist, and every man setting out to train himself should choose some particular branch in which to specialize. For instance, we have chemical research work and this field may be divided up into a number of branches. Then there is the electrical field which may also be subdivided. Mathematical and mechanical research work are two branches of note. Of course, it will be understood that no college training will enable a man to take up any of these fields. In other words, a man leaving college as a Research Engineer is not a Jack-of-all trades. His training will not permit it. Of course, his general training in science will enable him to enter a number of different fields that may be closely allied. For instance, a man who had trained himself along electrical lines would be able to take up any kind of electrical research work. However, such a man would be quite out of place in a chemical laboratory unless he decided to add to his training.

> *NOT so many years ago we were in the habit of marvelling at the efficient Germans, with their splendid research laboratories. In fact, many German concerns of even modest proportions were then maintaining research departments for the never-ending purpose of bettering their products and finding new ones. Today, after a lapse of a little more than a decade, we find the research department a feature of many of our leading concerns. Things are no longer done in a hit-and-miss manner. Instead, the failure of any given piece of apparatus or product must be pried into by the inquisitive research worker, better methods must be found in order to keep pace with market conditions; new products must be developed in order to meet the changing moods of a fickle public. The research laboratory has become an American institution, and a vast field of endeavor has been opened up for our young technicists. This is the story which Mr. Yates has to tell in this instalment of his series on success in divers technical fields.*—THE EDITOR.

At this point the writer is going to take the liberty of quoting freely from an article written by Dr. Whitney which appeared in the *Electrical World* of June 17, 1920.

"We seem to have plenty of ambitious young men, plenty of schools, infinite distance to advance and countless directions, but our engineering students are seldom practiced beyond the "shoulder arms." There is such a gulf fixed between the receiving of information and the doing anything about it that Davy teachers and Faraday students are unheard of."

Dr. Whitney believes that students should be encouraged to share in inspirational work instead of being subjected only to fact storage. Many college-trained research workers resemble a text-book on two legs when they step out of college. They lack imagination, initiative and practical working experience. The mere accumulation of facts, when carried beyond a certain limit, is apt to interfere with the imagination. Inventiveness depends upon imagination and every research worker must be an inventor. He must be able to invent ways of doing difficult things, producing new apparatus, etc. He must be able to imagine a certain result before he actually achieves it. In fact, his success depends greatly upon his imagination. The unimaginative, trained worker is only able to follow out the suggestions of others and he is destined to carry out routine work through his entire career. The creative urge in a research worker is an asset of great value.

Dr. Whitney went on to say: "We live in a period when the extent and the rate of increase in our mental horizon is maximum, when happiness has its greatest possibilities, and when human toil is everywhere being displaced and amplified by better latent energies. Never before was the individual and collective reward for new constructive effort so equitable. We are served by coal, oil, gas and water, with their countless accessories, better than ever before. Within a young man's lifetime we mined more iron, copper, coal and other ores, produced more kerosene, gas and gasoline, and put into use more of materials like cement and rubber than were produced by all the former inhabitants of the globe. And still the unfulfilled promises in Nature's books are greater than ever.

"Can we live up to this recent heritage? When we do many of the teachers of science will also be workers in science and better appreciated. *Engineering courses will prepare men to do new work where they now mainly create reverence for old.* It is easier to appreciate past developments than to extend appreciation to the unknown future, but, just as there is always more air for the trees as they grow upward, so is there more new knowledge as the existing branches spread. It is at the growing ends of engineering science that we ought to train our engineers.

"To the devotee scientific research may well become a religion, but whether he sees in the infinite possibilities of matter only the necessary results of permutation among seventy-odd decaying elements or the hand of an all wise Creator ever uncovering new principles to hopeful investigators, he cannot be blind to the blessings of new truth. This is not produced to order. Conventions do not establish it. It comes only from following with interest Nature's devious and unexpected ways, studying apparently irrelevant phenomena, learning by experiment, regardless of aim. And since it is important to us that pioneer effort be individualistic, wanton, clean, but vagabond, it is this rare type of teacher whom we must support.

"Practice in doing and planning to do are part of good engineering training. This was the ground for the introduction of laboratory and field work into engineering schools. This develops our efferent system, which, with the afferent and the will, is necessary to a well-rounded individual. Our sports illustrate it. No college sport could be put over if it did not contain some of the same elements which make engineering so attractive. No one would play the game if it were always a copy or a repetition. If there were no feared defeat nor hoped-for victory, no new stresses applied, no new materials discovered and no return but gate receipts, there would be no real amateurs and no real sport. When this is applied to engineering proper it meets a perfect analogue. Few good engineers play for the gate receipts, they are led on by a will to accomplish.

"During the season the ball team and the trainers work over all the novelties they can collectively invent. Groups of engineers do this all the time. Now, with a picture before us of a lot of healthy young Americans about the training table discussing moves never tried before, take a look at the present [illegible] professor and his class. Overlook the fact that the training table might be a good start for all of them. Are they wondering what would be the result of some new move, or raising questions not answered in the books? Usually not, because that would interrupt the ordinary system of fact storage. The natural wish and the will to try the new thing gradually weakens under the pressure of endless recitals of others' trials. The efferent nerve atrophies from lack of exercise, while the afferent palsies in exhaustion.

"The heart of this [illegible] is the hope that we may realize that we must raise and support as teachers inquisitive searchers of Nature."

The Role of Chemistry

Visions of Future Progress of the Human Race Through Chemistry as Set Forth in Recent Addresses

By Albert A Hopkins

THE meetings of the American Chemical Society and the Society of Chemical Industry were held at Columbia University and the College of the City of New York, these institutions lending themselves admirably to the necessity of minute subdivisions in sections The meetings were preliminary to the great Seventh National Exposition of Chemical Industries which was held the week of September 12th in a large armory in the Bronx One of the first matters discussed was the dye industry and resolutions were passed urging Congress to include in the permanent tariff bill a selective embargo for a limited period against the importation of synthetic organic chemicals and it was also resolved to urge upon the American delegates to the disarmament conference most serious consideration of the broad question of chemical armament as effected by the development and maintenance of the chemical industries in the various nations.

One of the first addresses and one of the most brilliant was by Sir William J Pope, retiring President of the Society of Chemical Industry of Great Britain It was entitled "Chemistry and Life" He declared for a chemical independence which would enable the development of material resources, especially in tropical lands, on lines not possible by methods originated in a self-contained European country He elucidated the vital processes in the utilization of carbon dioxide by plants. He showed that the laboratory methods of organic chemistry have developed in a perfectly natural manner in such a way as to cause them to approximate more and more closely in kind to those employed in the plant. Sir William said "It is safe to prophesy that the next great epoch of organic chemical progress lies in the very near future, and that it will lead us to laboratory methods of imitating with considerable fidelity the complex chemical changes brought about in living matter by the utilization of low potential energy"

If we believe this the logical conclusion to be drawn from our present state of knowledge and from the direction of development of method which has taken place during the acquisition of that knowledge, we must go further and foresee the advent of entirely revolutionary consequences which have wide bearings upon human affairs. The task of the chemical manufacturer has generally resolved itself into human labor and the use of coal, oil, water-power or other costly source of high potential energy, into finished materials marketable at an enhanced price which includes the cost of labor and energy In only a few instances has the technologist been able to avail himself of the activities of the living organism in the manufacture of acid, glycerol, and acetone by fermentation, labor and fuel have generally to be introduced as costly auxiliaries. When we possess full working details concerning the plant-leaf process for converting carbon dioxide and water into formaldehyde and oxygen by utilizing the sun's energy, when we can make indigo and quinine by the identical methods adopted by the plant, chemical technology will be an entirely different proposition from the one which it now represents. Not that it is likely that we shall desire to replace the laboratory of the living organism as a source of natural products, it is difficult to believe that the indigo plant, properly developed and properly worked up, is not capable of competing successfully with coal-tar as a source of indigo. The elucidation and imitation of plant and animal chemical methods will, however, provide us with means for manufacturing vast numbers of products which are unknown in nature, because the lower creation has no need of them, we are nowadays so far from naturé that many such products may be of the utmost value to modern civilization

Considerations of the kind which have just been advanced force upon us yet other reflections. Fuels and other sources of high potential energy are becoming more scarce, human labor is becoming more costly, that is to say, is becoming less willing to expend itself, on all hands we are met by the demand and indeed by the expectation that science will lift the curse of Adam from humanity. It is no part of my task today to discuss philosophical questions which originated in the Garden of Eden, but it seems plain that modern science is called upon to find means for curtailing the expenditure of such high potential forms of energy as human labor and mineral. The solution of this problem must come from the proper utilization of the radiant energy which comes to us from the sun; we require efficient methods for transporting solar energy from the tropics for use in our more temperate climes. It is perfectly possible that the scientific study of oil bearing plants in tropical regions may lead to such improvements in yield and cost of production that vegetable oils will replace the ordinary fuels, coal and petroleum, now used the whole world over.

Sir William also spoke of mustard gas as an aid to warfare, at another meeting he showed that much of the opposition was based upon false premises and that it was shown by experience that poison gas is far less fatal and far less cruel than other forms of warfare He pointed out that the responsibility for warlike operations rests upon the medical man and the chemist as fully as upon the soldier, contending that former philosophy of war has taken an entirely too narrow view of the situation

Among the other papers and addresses of great prominence were those of Dr Arthur D Little, Dr R. H Baekeland, Prof Wilder D Bancroft, Dr Edgar F Smith, Dr C E. K. Mees, Dr Charles Baskerville and many others which we can only touch upon briefly Dr Little spoke upon "Energy, Its Sources and Future Possibilities" in which he asked "Upon what sources of energy may the world draw for the stupendous work of reconstruction at the requirements of the new social era, at the threshold of which we seem to stand?" In answer to the question he continued in part 'In appraising the sources of energy we must consider form values as well as quantities available. Gasoline can be utilised more effectively than coal The

> *THE meeting of the American Chemical Society and the Society of Chemical Industry, which was held in New York a few days ago as a prelude, so to speak, to the Seventh National Exposition of Chemical Industries, resulted in a sheaf of addresses. These addresses were more than remarkable — they were epoch-making Nothing of late has served to open our eyes more to the possibilities of the immediate future in the field of chemistry than many of the remarks and predictions and hypotheses of the leading chemists gathered at the various sessions We assigned one of our Staff, Mr A A Hopkins, to attend the various meetings and to report the most important features in these columns* —THE EDITOR.

development of waterpower involves a heavy initial expenditure, and therefore interest charges are the chief item of expense In a steam station of the same considerable size—20,000 horsepower—interest shrinks to less than 20 per cent of the operating charge, and the high cost of coal at \$3.25 delivered is nearly 50 per cent. The energy of the wind and the closely allied energy of the waves is too uncertain and diffuse to justify extensive exploitation. In a few exceptionally favorable locations it is feasible to utilise a trivial fraction of the total energy of the tides. The intermittent flow, the varying head, and the other special conditions involved in the problems are likely to hold the development of tidal power within closely restricted limits. Of extraordinary interest are the accumulating evidences of inconceivably great amounts of kinetic energy possessed not only by radium, but by ordinary matter as the constitutional energy of its atoms. We now recognise that concealed in matter of every kind are stores of energy immensely greater than those derived from chemical reactions or concerned with any of the forces with which we commonly deal. We recognise them as of an altogether higher order of intensity and magnitude than the energy derived from burning coal or liberated from the most powerful explosive So stupendous and far-reaching are the possibilities contained in the suggestion that we may ultimately be able, without destruction, to draw upon this energy supply of which Rutherford has said 'The human race may date its development from the discovery of a method of utilizing atomic energy'"

Dr C. E. K. Mees, of Rochester, explained the tremendous part that research work has played in the world's development during the past forty years. "Diffusion and Its Relation to Civilization" was the topic of Dr Ernst Cohen, professor of chemistry at the University of Utrecht, Holland His address was especially analytical as well as technical

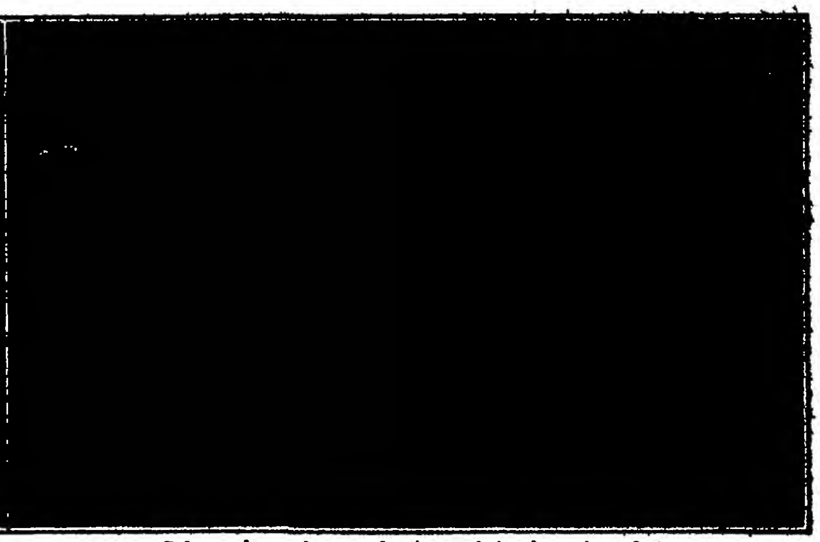
Dr Charles Baskerville delivered an address entitled "Science and Civilization, the Rôle of Chemistry,' which concluded in the following words "Chemistry must plan a great rôle in preparing the dramatic generalizations necessary for the third part of this master human guide, the 'cement' will bind mankind in brotherhood With all deference to the followers of all the arbitrary divisions of science, it may be positively asserted that life processes depend upon chemical changes, speed of the changes, diffusion of the products energy involved its direction, and what not other factors with many of which we are already familiar through published researches Their direction will depend entirely upon the factors in the systems and how man controls them Unleased energy might bring sudden destruction. Super-controlled energy may result in equilibrium When equilibrium of energy has come about, none will be available and life all life, inorganic as well as organic, will cease Our world will have come to an end The degradation will be as imperceptible as the growth That which is and was returns to that which has been forever The quiescent ocean of energy in equilibrium, the source and recipient of all life Creation's chorus is stopped, 'hid in death's dateless night. Gone—all gone—like the light on the clouds at the close of day'" Dr Baekeland predicted that chemistry will reveal new forces of vast aid to the race It was a particularly brilliant address, ending as follows 'But motion, whether it be furnished by water rushing from a waterfall, or by steam or gas engine, or by a windmill, can be made to turn a dynamo and produce electrical energy The latter, in turn, can be changed into motion, heat or light. Or again, we can bridge directly that jump between a chemical reaction and light by simply burning oil, gas, acetylene or magnesium, and thus produce any range of even the most intense light In other cases, we use heat or electricity to decompose the most refractory substances into their elements, and some of our largest electric chemical industries at Niagara Falls are based on this. Or we may use either one of these forms of energy in chemical reactions which build up, which, in other words, bring about chemical synthesis. But when it comes to transform light energy into chemical synthesis we have left thus far the monopoly of this to Nature, we have been acting as Rip Van Winkle.'

The value of theoretical knowledge was emphasized in an address entitled "Theories," delivered by Dr Willis R Whitney, of Schenectady, N Y, a research chemist connected with the General Electric Co. Dr Whitney, in the beginning of his address, spoke as follows "I define theory as mental concept as distinct from practice, which is always material But for the scientist the combination of these two is necessary. They may be antithetical but they are not antagonistic As allies, they are invincible A theory is a means of satisfying the mind, when, for sake of economy, order and mental increase, various thoughts first form into a conjecture, then into an hypothesis, and then into a full grown theory This is always a process concerning some selected group of apparently related observations There is warrant for instinctive appreciation of theory in science The world owes the present stand of organic chemistry to a beautiful combination of theory and experiment. We now see it plainly in this industrial situation. In 1856 Perkin produced the first artificial dye At that time Kekule was theorising, and he then laid the foundation of all our modern structures His theories, which soon led into the wonderful conception of the benzene ring, are now the A B C of the dye industry"

Salvage of the by-products of industry, substitutions for natural materials that are difficult to obtain and more economy by manufacturer and user were the general subjects of a score of papers read before various sections of the American Chemical Society at Columbia University With natural resources dwindling and manufacturing organised on a vast scale, the research laboratories of the chemists have been assigned to these tasks. The salvage problem was taken up extensively by the section of petroleum chemistry, and Dr Sidney Born, of Muskogee, Okla, said that millions of dollars could be saved annually by the re-

(Continued on page 245)

Drying opium for local use in India



Cake makers about to begin work in the opium factory

Juice of the Poppy

The Cultivation, Manufacture and Taxation of Opium in India

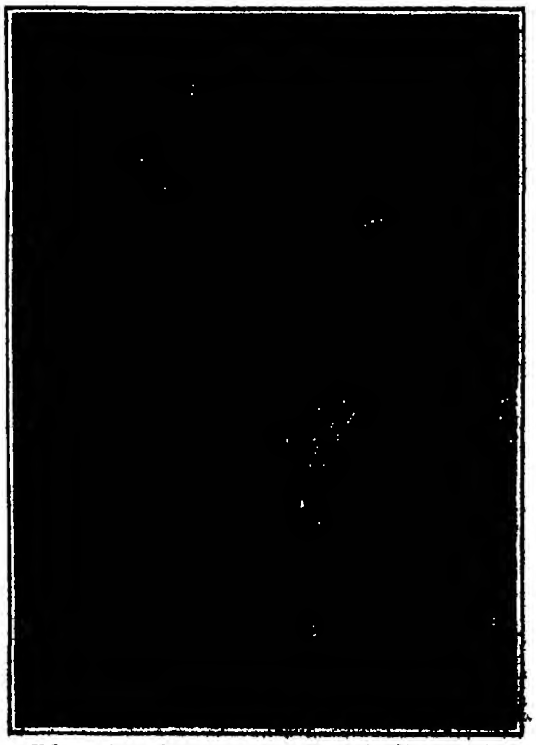
By T Gibb

OPIUM is an inspissated juice obtained by scratching the unripe capsules of the opium poppy *Papaver Somniferum* and allowing the milky sap which exudes therefrom to dry spontaneously There are two main varieties of the drug—that used for medicine (produced chiefly in Asiatic Turkey) and that smoked eaten etc (grown in India and China)

All authorities are agreed that Asia Minor was the original home of the *Papaver Somniferum* The merits of its seed as an article of food and as affording a sweet edible oil were extolled by early Greek writers long before the somniferous property of the capsules had been discovered The capsules stems and leaves were employed by the Greeks in the preparation of an extract called *meconium* used in the fabrication of a soothing beverage corresponding to the *post* of the Punjab today The Greeks must be credited with the discovery of the potent nature of the inspissated juice of the capsules which began to attract attention about the third century B C But if this discovery is credited to the Greeks, the Arabs were chiefly concerned in disseminating knowledge of the plant and its uses There can be no doubt that the followers of Islam brought a knowledge of the properties of opium the *opion* of the Greeks to the people of India and China There is strong proof of this in the Semitic corruption of *opion* into *afyun* and *a fou-yong* the name of the drug in most Indian and Chinese vernaculars respectively

The history of the production and use of opium in India before the beginning of the 16th century is obscure At the beginning of the 16th century the export of the drug from India to China had not only been fully established but the cultivation of the poppy plant and the manufacture of opium had become regular industries The State monopoly of manufacture of the drug the strict government control of the cultivation of the poppy and supervision of sale of the drug to the consumer are direct legacies from the Muhammadan rulers of India and from the early Portuguese traders. Control was assumed by the British in 1757 shortly after the battle of Plassey and continues to the present day Control of cultivation and manufacture of the drug is in the hands of the Opium Department and supervision of sale rests with the Excise Department

The opium year opens in September when the preparation of the land for the reception of the poppy seed commences The soil is ploughed at an interval of every ten days, till the middle of October when sowing begins. Land in the immediate vicinity of the village is selected on account of its being higher, usually more richly manured and more easily supervised. The crop requires an abundance of water and irrigation commences as soon as the plants appear The plants take from 75 to 80 days before full flowering can be said to be attained The petals four in number are removed from the capsule the third day after expansion This operation demands considerable skill since if plucked off before they are ripe the capsule afterward produces much less opium than if the petals are allowed to mature fully The hand is placed gently round the base of the flower drawn upwards, when if properly matured, the petals come away naturally After collection they are made into what are technically called leaves To accomplish this a handful of petals is placed on an earthen plate over a slow fire Over the petals is placed a damp cloth and pad and the steam from the cloth causes them to adhere together. The thin cake thus formed is turned over and the damp pressure repeated to ensure the union of the petals on both surfaces The leaves have a pleasant aroma which they are said to impart to the opium for which they are employed subsequently as packing material The collection of the drug begins immediately after the gathering of the petals The green capsules are scratched in the afternoon with an instrument called the *nashtar* This consists of four sharp blades tied together with cotton and with a padding of same between each so as to keep them about one-thirtieth of an inch apart to allow of scratchings being made to a certain depth through the wall of the capsule and no further It is important that the wall of the capsule be never completely severed but at the same time a purely superficial scratching is useless The exact degree of penetration to ensure the best possible flow of juice requires considerable skill Incisions are made from below upward As a rule each capsule is lanced in this manner three or four times at intervals of two or three days. Sometimes a single scratching may exhaust the flow, while occasionally an extra fine capsule may give eight to ten discharges The field is divided, usually, into portions so that scratchings may be performed, in regular rotation, until the entire crop is collected The juice adhering to the incisions is scraped off with a small trowel-shaped scoop of thin iron called the *seteoah* in the early morning on the day following the scratching The drug is transferred from the scoop to a metal or earthen vessel and conveyed to the farmer's house for further manipulation It is stored in an earthen pan tilted to one side to allow the liquid *pasewa* to drain from the more solid extract the crude opium, which in the case of opium grown in British India, finds its way in the manner to be described later, to the Government opium factory at Ghazipur



Where the opium cakes are stored at the factory

Here the crude opium is first tested for purity and quality and stored in large wooden boxes During storage it deepens in color by exposure to air and light The quantity to be manufactured daily is sampled, assorted kneaded together and thrown into boxes. The opium is next placed in troughs, kneaded, and thoroughly mixed by men wading knee-deep in it. When uniformity has been attained by these various stages of separating sampling mixing, and kneading, it is next day made up into cakes For this purpose a supply of leaves *lewa* a paste made of inferior opium and *pasewa*, and trash (pounded poppy stalks) is required The leaves" and opium required for each cake are accurately weighed out The operator, taking a brass cup in his hand places the leaves within it layer upon layer after moistening with the *lewa*, and builds up a *shel* and leaves moistened in the *lewa* are inserted until the space round the cake is filled up. The leaves are then brought up over the opium and pressed together until the finished cake resembles a Dutch cheese in size and shape. It is then removed from the cup, rolled in the "trash, placed in an earthen cup of a size to hold it comfortably, and dried through exposure to the sun Half the weight of the average cake consists of the *shel* that surrounds it. Opium prepared in this way is packed into chests intended for export from India The opium intended for sale in India is inspissated by direct exposure to the sun until the standard consistency is attained. It is then moulded into cubical cakes of 3½" dimension and weighing about two pounds, which are wrapped in [illegible] Nepal paper and packed in chests for transport.

Two main centers of opium production in British India are (a) the districts of the United Provinces of Agra and Oudh lying along the Ganges valley and north of it and (b) the Native States in the Central India and Rajputana Agencies, [illegible] opium purposes, are [illegible] way. There is also [illegible] grown in (a) is [illegible] Malwa opium. [illegible] British India, with [illegible]

ports from Afghanistan and small native states in the Simla Hills, is of the Bengal variety collected by the opium department and manufactured at the Government factory at Ghazipur. Cultivation in the Bengal opium region is permitted only under license from an authorized officer of the opium department; and the cultivator, who receives advances when required to assist him in production, is bound to sell the whole of his outturn to the department for manufacture at the Government factory. This factory, in turn, issues the manufactured drug to the Government treasuries in the various provinces at a price fixed to cover payments to cultivators, factory and establishment charges, etc. The drug is sold, again at a fixed price, from the treasuries to licensed wholesale and retail vendors for sale to the public. The opium revenue is represented by the difference between the factory price, *i.e.*, cost of manufacture, and the sale price at the treasury, which varies according to local circumstances. The vendors pay, in addition, a considerable fee for the right of sale. The total revenue recovered from both sources, in 1912-13, amounted to £1,300,000. The main source of the opium revenues of India, however, is the export tax which is levied in the following manner The opium prepared for export by the Government factory is despatched to Calcutta for sale there by public auction. The number of chests to be thus disposed of is fixed, annually, by the Government of India, according to probable requirements. The sales are conducted monthly, by the Bengal Board of Revenue During the year 1912-13 900 chests were sold which, after deducting expenses of production, realized a net profit of, approximately, £4,526,000, which represents the taxation on exports. The chests, on sale, become the property of the exporters, but must be shipped under passes granted by the Board of Revenue, and subject to conditions which prevent the opium being used for consumption in India Till so shipped the chests remain in the official store-rooms.

As observed above, Malwa opium is, almost entirely, produced in Native States, and there the Government of India do not control its production or sale. This opium was formerly exported to China, but with the cessation of the opium trade between India and that country export has entirely ceased. The last exports took place in 1913-14 to the extent of 2700 chests. While the trade lasted each chest, on export, paid a tax of £80 to the British Government. The import of Malwa opium into British territory is prohibited, but parcels of the drug are occasionally purchased by Government for blending with the Bengal variety at the Government factory

The Government of India have always regarded the opium trade as one which needed careful control, and in recent years have adopted a very definite policy of restriction. This forward policy dates from the decision of the Chinese Government to suppress opium smoking, and the findings of the International Opium Commission which met at Shanghai in 1909 The necessity for the suppression of opium smoking, and the advisability of either prohibiting or regulating carefully the use of the drug for any other purpose, are fully recognized Opium smoking is uniformly reprobated in India. The sale of opium for smoking is absolutely

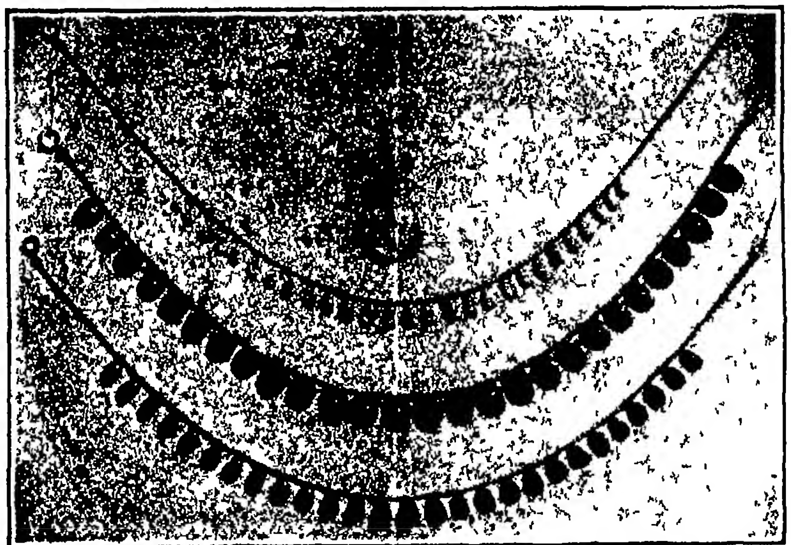
(*Continued on page 243*)

Some of the attractive stick-pins and similar large pieces of jewelery made up about a beetle or other insect as a base

The Jeweler and the Beetle

THE Pharaohs of old Egypt had their scarabs, and in collections and museums we may still see these curious jewels. But modern times have not seen any material use of insects or insect patterns in the jeweler's arts. Today, however, there is quite a vogue in Paris calling for the incorporation in pendants, necklaces and pins, not of the mere counterfeit presentment of insects, but of the actual insects themselves, preserved in one way or another The Parisian jewelers follow here the lead of the Egyptians, in that they employ for the most part exotic coleoptera (in the vulgar tongue, beetles) of warm and iridescent colorings.

Our illustrations indicate some of the possibilities, and make it appear that the beetle jewelry, in spite of its bizarre character, has certain features of attractiveness. The smaller species, like the lady bugs or lady birds or lady beetles, known under one or another of these names wherever English is spoken, are for the most part seen in the form of necklaces or circlets of some description, while the larger beetles are nicely available for use, single, in more pretentious ornaments of the clasp or brooch or stick-pin order We are assured by the French contemporary from which we glean the particulars of this curious fashion that the insects worn by miladi in this manner are by no means stone replicas, but actually *the natural insects themselves*, metallized or ossified according to one of several processes known for this purpose. The variety of treatment of which this type of jewelry is susceptible is wide, and the results far from displeasing

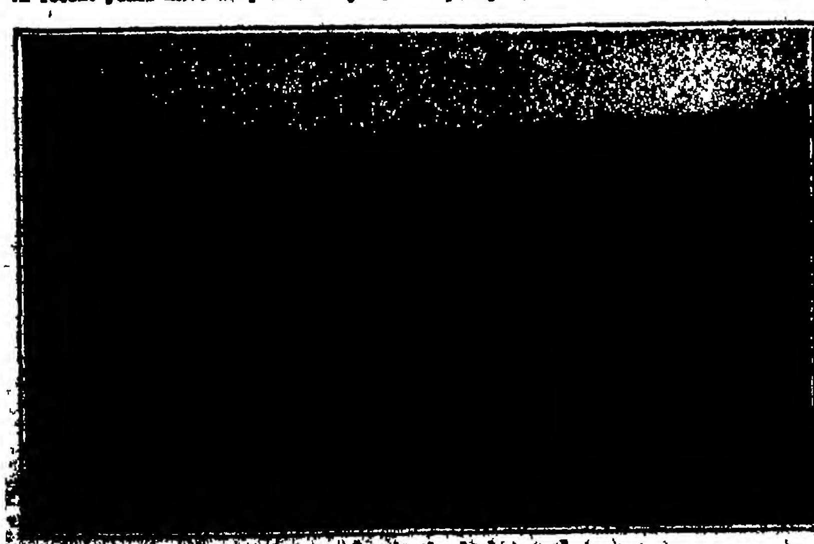


The smaller species are equally available for the production of striking necklace effects, and even the butterfly can be hung about milady's neck

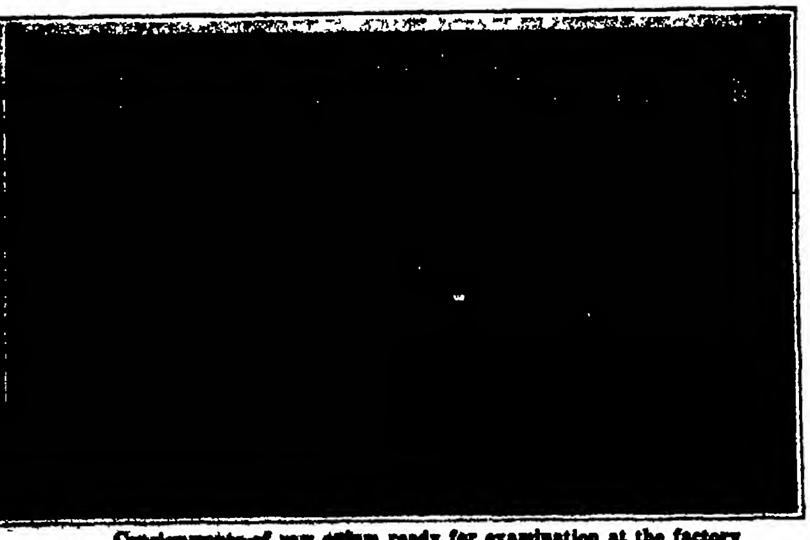
Discovery of Unknown Substance in Soil

PROCLAIMED by the Bureau of Soils, United States Department of Agriculture, as the most notable discovery pertaining to the science of soils within recent years is that of identifying a hitherto unknown substance in the earth Designated as ultra-clay, its characteristics are described as being sticky and plastic when under the influence of moisture and resembling resin when subjected to a drying atmosphere When analyzed, it has the appearance of being a silicate of alumina, partaking of some iron and traces of potassium, sodium, magnesium, and calcium.

The discovery is reported to have bearing on the physical properties of soils, a factor for consideration by the Bureau of Public Roads in determining its relation in adjusting the structure of concrete and other road surfaces to the texture of the soil serves as their foundations. The ultra-clay, according to an opinion of Government experimenters, is a primary contributing agency in rendering the soil plastic Briquets constructed of ultra-clay crumble in water while Portland cement retains its form —By *S P Winters*



Opium cakes in the drying yard



Consignments of raw opium ready for examination at the factory

The Heaven's in October, 1921

Betelguese Dethroned from the Seat of Honor, and New Light Gained on the Atmosphere of Venus

By Professor Henry Norris Russell, Ph.D.

A NUMBER of interesting astronomical items, mostly from the Pacific Coast observatories, have recently been made public and may be reported here

Professor Sitken at the Lick Observatory finds that the remarkable nebula surrounding the "new star" which appeared in Aquila in 1918 is still visible It has now reached a diameter of five seconds of arc and—if the velocity of expansion is about 170 kilometers per second, as indicated by the spectroscopic data—its real diameter must be about 2200 times the earth's distance from the sun

Throwing Betelguese in the Shade

Mr Pease, at Mount Wilson working with Michelson's interferometer, has measured the diameter of another star—Antares—the brightest member of the constellation Scorpio The apparent diameter, 0".039, is a little less than that of Betelguese though much greater than that of Arcturus, but the real diameter is extraordinarily large Antares shows the motion of the neighboring bright stars in Scorpio, which Kapteyn has shown to belong to a great cluster at a distance of between three and four hundred light-years from the sun For the individual stars of the cluster, the distances can be more accurately determined, and that of Antares is found to be 370 light years, corresponding to a parallax slightly less than 0".009 It follows that the true diameter of this star is 420 million miles—more than twice that of the earth's orbit, and half as big again as Betelguese

Startling as this result may seem, it has been pretty well anticipated by students of stellar matters Antares, though looking fainter than Betelguese, is twice as far away, and is in reality three times as bright. Moreover, it is fully as red as Betelguese, and so probably gives out rather less light per square mile, so it is not surprising to find it the bigger of the two stars. Its actual luminosity is about 3000 times that of the sun, but according to these measures its diameter is about 500 times the sun's, and its superficial area about 240,000 times as great This shows that, per square mile, Antares gives out only one-eightieth as much light as the sun—that is, that the surface of this star is much less luminous, and probably cooler, than the darkest parts of any sunspot This again is not really surprising, for the spectrum of Antares marks it decisively as one of the least intensely heated of the stars.

Additional evidence of the remarkable, and almost unique, character of this great luminary is found in an observation by Mr Joy—also with the 100-inch telescope at Mount Wilson Antares has a much fainter companion, three seconds of arc away, which is so overpowered by the rays of its great neighbor that it affords a rather severe test of the defining power of telescopes of moderate dimensions. This companion appears vividly green—but until recently it was uncertain whether this color arose merely from contrast with the deep red of the primary, or was real. Mr Joy's spectrographs show that the companion is remarkably unlike Antares. Its spectrum is of the Orion type—B3 on the Harvard scale—which means that it is a very hot star indeed, much above the temperature of Sirius, and far exceeding the sun. Though so hard to see in the glare of Antares, it is really fairly bright—of about the sixth magnitude and its real luminosity must be about fifty times that of the sun, or twice that of Sirius. Being so hot, it probably shines very intensely—twenty times the sun's surface brightness being a low estimate, and we may therefore conclude that its linear diameter is not far from one million miles.

Though the companion is so extraordinarily unlike Antares in almost every particular, the two stars undoubtedly form a true binary pair They are moving together in space, and show traces of orbital motion, which however is exceedingly slow

It is worth emphasizing that it is Antares, and not the companion, which is the exceptional object. Almost all the other stars which belong to the "Scorpius cluster,' as Kapteyn calls it, show the B type of spectrum, and the companion of Antares, though fainter than most of the others, does not differ from them very materially It is only the presence of its enormous neighbor that makes it seem insignificant.

The Atmosphere of Venus

One more bit of news, also from Mount Wilson, may be mentioned Dr St John and Mr Nicholson, photographing the spectrum of Venus, have made a very careful search for lines arising from absorption by oxygen and water vapor in the planet's atmosphere, with the very interesting conclusion that no trace of either can be found This investigation would have been very easy, except for one obstacle that made it very difficult The spectral lines in question are in the red but can be very easily photographed with modern plates. But the earth's atmosphere is full of oxygen and water vapor, and heavy lines arising here are always present, complicating the situation greatly It is possible, indeed, to go boldly ahead, observing the combined effects of the atmospheres of the earth and the planet, and then attempt to disentangle the two, but a better road was pointed out some years ago by Campbell. If Venus is observed near elongation, when her distance from the earth is changing rapidly, the lines produced in the atmosphere of the planet will be shifted toward the red or toward the violet by an amount corresponding to this radial velocity, while the lines produced in the earth's atmosphere will be unaffected. By using a spectroscope of high dispersion, the two sets of lines may be separated clearly, so that, if oxygen is present in the atmosphere of Venus, each terrestrial line will have a close companion.

When the photographs were examined not the faintest trace of such companion lines appeared, and there seems to be no escape from the conclusion that if oxygen or water vapor exist at all in the atmosphere of Venus, they must be present only in minute amounts—the merest traces.

This surprising result is confirmed by simultaneous, and independent observations by Dr. Slipher at the Lowell Observatory, using the other method, and comparing the intensity of the lines in the spectrum of Venus (arising from the combined absorption in the atmospheres of the planet and the earth) with those in the spectrum of the moon, where nothing but the earth's atmosphere comes into play Careful measures led to the same conclusion—the amounts of oxygen and of water vapor in the atmosphere of Venus are negligibly small.

It must be remembered that these results apply only to that part of the atmosphere of Venus which lies above the visible surface It is fairly likely that this surface is composed of clouds. If these clouds are like the high cirrus clouds on the earth, they may lie at the very top of the part of the atmosphere into which water vapor is carried by ascending air-currents, and the upper regions, as here above the earth, may be almost absolutely dry

But the apparent absence of oxygen is more puzzling. We naturally expect to find oxygen in the atmosphere of another planet, because it exists in our atmosphere and we cannot live without it. But after all, free oxygen is a remarkably active chemical substance to remain permanently in an atmosphere. We know that on earth it is being continually consumed by chemical action, and as continually renewed by the activity of vegetation. On a lifeless planet, there would be presumably very little oxygen in the atmosphere Hence we may take these recent observations, tentatively, as indications that there may be no life on Venus. The application of the same test to Mars (which involves much more serious observational difficulties) may go far to settle the vexed question of the existence of life upon the surface of this planet.

At 11 o'clock Oct. 7
At 10½ o'clock, Oct. 14.
At 10 o'clock Oct. 22.

At 9½ o'clock: October 30.

At 9 o'clock Nov 7
At 8½ o'clock: Nov. 16
At 8 o'clock Nov 23.

The hours given are in Standard Time.

NIGHT SKY: OCTOBER AND NOVEMBER

The Heavens

Our map shows the appearance of the evening skies. We may begin right overhead, at Pegasus, marked by the great square whose eastern side is just on the meridian This edge, carried down and bent a little to the left, points out the second magnitude star Beta Ceti The western edge of the square points downward to the brighter star Fomalhaut, in the Southern Fish These two are the only prominent objects in the southern sky

In the west we find Aquila, and in the northwest Lyra, with Cygnus above. The Great Bear is low on the northern horizon, with Draco and Ursa Minor above, and Cepheus and Cassiopeia still higher Gemini is rising in the northeast, and Auriga and Perseus are above. Orion is on the eastern horizon, with Taurus above him, then Aries, and Andromeda above all Eridanus and Cetus fill the dull southeastern sky

The Planets

Mercury is an evening star, except on the last day of the month. On the 7th he is at his greatest elongation, 25° east of the sun, but is so far to the southward that he sets at about 6.30 P M, and is hard to see (as is always the case when he is an evening star in autumn).

Venus is a morning star, rising at 4 A. M. in the middle of the month, and very conspicuous.

Mars is also a morning star, and so are Jupiter and Saturn. All four planets are close together in the sky, and a series of interesting conjunctions occurs as Venus, which is moving eastward faster than the others, overtakes them one after another. On the 3rd she comes within eleven minutes of arc of Mars; on the 22nd she passes 35 minutes south of Jupiter; and on the 26th she is 31 minutes north of Jupiter. Between these dates all four planets are crowded into a space no longer than the belt of Orion, and as they are far enough from the sun to be easily visible before daybreak, the display will be well worth getting up to see—especially as such triple conjunctions are rare. The last in which these planets figured happened twenty years ago.

Uranus is in Aquarius and is observable until well after midnight. Neptune is in Cancer and rises about 1 A. M.

(Continued on page 248)

Doing Away with Postage Stamps

ONE of the latest aids to expediting business, at least the office routine phase of business, is a machine that does away with stamps on pieces of mail This machine, the invention of Arthur H Pitney, is being tried out by leading banks and large concerns in New York City, with the aid of the Post Office, in order to determine whether it can eliminate the paper stamps altogether

After all, the idea of the paper postage stamp is to show that a certain sum of money has been paid to the Post Office The affixing of a stamp to any piece of mail matter indicates the exact amount of money paid Any device that serves to indicate the same thing, and which insures the payment of the total amount of the mailing charges to the Post Office, obviously serves the same end Such a machine is said to be represented by the new stamping machine, which is shown in the accompanying illustration. This machine seals the envelopes and prints a Post Office license in the usual stamp corner The stamp printing machine can not be started until the operator has inserted the meter which keeps track of the stamp impressions. The meter, in turn, is set by the Post Office officials and is sealed in such a manner that it cannot be tampered with This meter keeps watch over the stamping activities of the stamping machine, yet may be removed and carried to the nearest post office for re-setting and for the payment of the postage stamped off by the machine In this manner, so it would seem, the machine has solved the postage problem It is said that on the average of 250 letters are stamped per minute and sealed in the same operation.

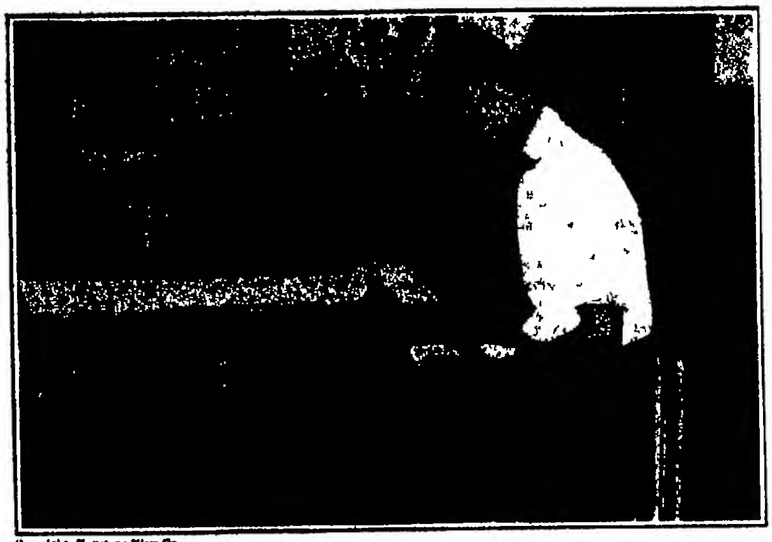
From Greenhouse to Swimming Pool

NOT because he loved flowers less but because he loved swimming more, H O May, of Summit, N J, converted his greenhouse into a swimming pool, as shown in the accompanying view In fact, it would seem that Mr May's improvision has worked out very nicely, for the cement floor and sides of the usual well-constructed greenhouse require little additional work and materials to form a highly satisfactory pool Then there is the splendid sunshine which pours through the glass roof and sides, so that even in the coldest weather the pool is kept warm, especially with the aid of the usual steam pipes which line the greenhouse

A Novel Departure in Typesetting Machines

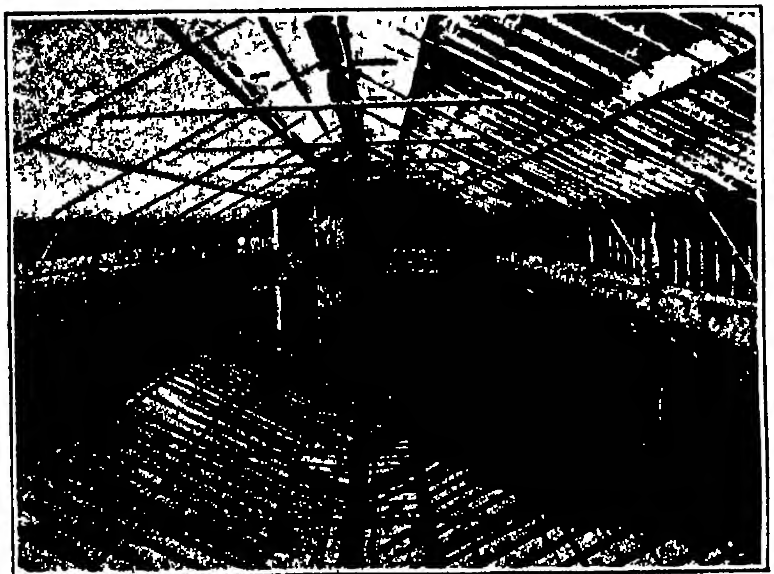
ON the very face of it, it would seem as though two inventors, A. F Osterlind and F C Damm, both of Saint Paul, Minn, have replaced the complicated and bulky type-setting machines, which have long been characteristic features of the modern printing plant, with a machine that startles one with its absolute simplicity We learn that the two inventors had been working along the same general lines for many years, but it only required the meeting of these two minds and the exchanging of their ideas some two years ago to bring about this new conception in type-setting machinery

The new machine is a matrix-setting line-casting device, containing many features not heretofore attained by other machines of like nature, so claim the inventors. The line is assembled the same, but when assembled the operator touches a key and the line automatically passes directly into the jaw in position for casting. Each line is followed by a master matrix which holds the succeeding line. There is no elevator to wait for, nor are there any return stops or springs, all of these annoying features being discarded entirely, and the line when cast is ejected



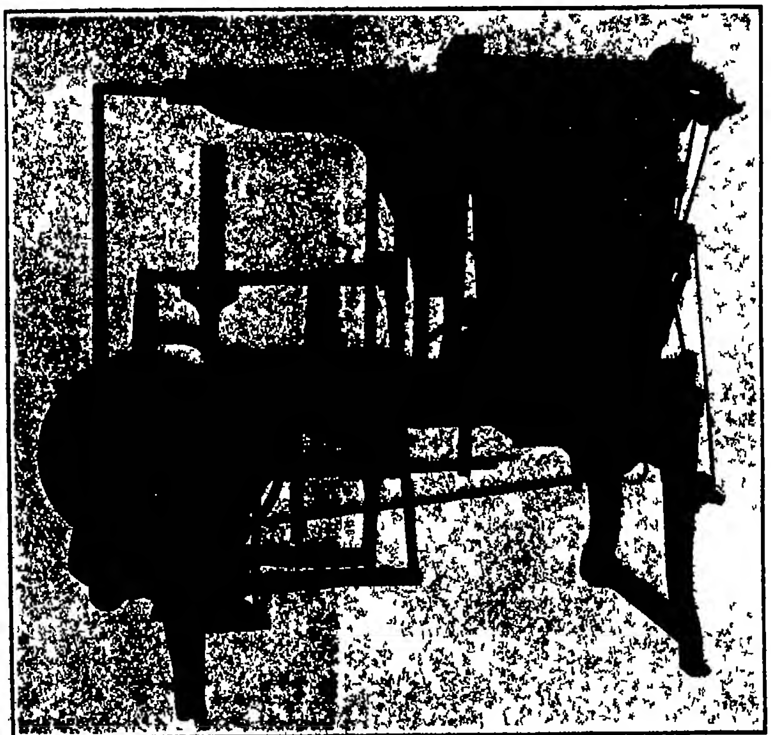
Copyright, Keystone View Co.

This machine automatically seals the envelopes and stamps them with a Post Office license that takes the place of the usual paper stamp



Copyright, Kadel & Herbert

Which is top and which is bottom? Perfect reflection in the greenhouse swimming pool of a New Jersey resident



General view of a new typesetting machine, which differs radically from the usual equipment of this kind

by means of the liner which is a part of the mold The length of the line is determined by a dial that can be set in less time than it takes to tell it—varying from 2 ems to 38 ems in length, and from 5 point to 42 point in thickness. The machine especially intended for the large display types of advertising composition, has a range from 42 point to 102 point.

The magazines, of which there are six, are shifted to position simply by operating the small lever up or down, the movement being about one inch for each change There are no cranks or wheels to turn—each movement is positive and accurate and made instantly

The metal pot holds 100 pounds of metal The well is separate from the main pot, though heated by the same flame The mouthpiece and throat are easily accessible by means of a very ingenious method, making cleaning a matter of minutes rather than hours and no special saws, brushes, drills or tools are necessary The slugs cast by the machine are solid top and bottom, supported in the center by a solid support

In sum, the new type-setting machine is claimed to be unequalled in the matter of speed due to the simplified mechanism Only one half as many parts are needed in this design, as compared with the usual type-setting machines.

A Word to Inventors and Licensees

WE think it well to warn patentees who grant licenses for the use of their inventions, that they should be careful to protect themselves from unscrupulous parties who take advantage of the present state of our patent laws to deprive inventors of a part of their profits to which they are morally entitled

We refer particularly to the case where the licensee of a patented device, which he has not purchased, keeps it in repair by replacing broken parts made in his own shop or factory, sometimes even going so far as to buy from unlicensed makers a line of repair parts to be kept in stock and used on occasion

This is morally wrong, but as the law allows the licensee of a patented machine to make repairs in case of breakage or failure, without clearly defining to what extent such repairs may be made, many licensees systematically replace broken parts as above alluded to—a practice which in course of time results in the production of an entirely new machine with nothing of the original structure left.

In view of the above inventors would do well, when selling their patented devices, or licensing others to use them, to have their contracts so drawn as to require the licensee to purchase from the owner of the patent all replacements for broken parts.

It appears that the chief delinquents in the premises are the railroad companies. One reason for this may be found in the fact that repairs to railway machinery have to be made in the shortest possible time to prevent traffic delays, and during the war there was some excuse for thus encroaching on the rights of patent owners. But we are now getting back to normal times, and the fact that property in patents is just as inviolable as in chattels or real estate should not be lost sight of, especially by the railway people. It may safely be said that our vast railway system has been built up by our patent system An examination of the patent records of the United States and Great Britain discloses that nearly all the improvements in railway machinery were originated by inventors and have come to us through the Patent Office.

It would seem that the law as it now stands works an injustice to inventors in the way we have indicated, and we think some amendment would be advisable.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Edge view and flat view of a screw driver that holds screws by means of their slot

A Screw-Driver that Holds Tight

A WISCONSIN man has recently introduced an interesting automatic self holding screw driver The screw is placed on a two point blade and locked by a spring lever rod It is claimed that this tool may be used around electrical or running machinery because of its insulation against current leakage and its power of holding a screw without danger of dropping it

One-Million-Volt Transmission Experiments

SUCCESSFUL generation of electric power at more than one million volts at commercial frequencies has just been accomplished at the High Voltage Engineering Laboratory of the Pittsfield Works of the General Electric Company During the course of the experiments just completed much valuable data was gathered indicating the feasibility of considerably higher transmission voltages

Physical laws applying to high voltage phenomena were found to hold good at these enormous potentials In the course of the experiments the gap spacings for sphere and needle spark gaps were carefully checked up and prolongation of existing curves (750 000 volts and below) were found correct up to 1 100 000 volts

Arc over tests were also made on strings of standard ten inch suspension insulators up to 1 100 000 volts The laws of corona were checked at similar potentials and found to hold A short transmission line was tested for corona conditions and results indicated that a line using four inch diameter conductors or larger would be necessary at 1 000 000 volts.

The successful conclusion of the tests is the result of more than thirty years of constant experimentation during which time transmission voltages have arisen steadily from the first 15 000 volt line built in Pittsfield in 1891 to the present record breaking voltage of 220 000 volts equipment for which was recently shipped from Pittsfield and is now being installed on the Pacific Coast

The million volt tests confirm the belief of the Pittsfield engineers that it will be commercially feasible to use considerably higher voltage in the transmission of power and indicate the extension of long-distance transmission beyond limits heretofore believed possible Electrical engineers are now in a position to forecast results

Fifteen to One Hundred Phonographs Records Without a Stop

THE latest novelty in the phonograph ic field is a machine that handles its records automatically and continues playing one record after another until the supply is exhausted Indeed as many as one hundred records may be played without a break and without attention of any kind

One record at a time is automatically dropped on the turn-table so that as many as 100 records may be played without a break

The device which makes this automatic operation possible is shown in the accompanying illustration A batch of records is placed on the turn-table of the phonograph and all but one record are raised by hand and held in place by the arms or fingers mounted on the pillars on either side of the turn-table, as shown When a record is through playing the tone arm automatically lifts and falls back whereupon a new record is deposited on the turn table It is said that the record is carefully dropped in place with no danger of breakage The tone arm is then brought into position with the stylus in the first groove, and the record begins playing By extending the pillars upwards and mounting more arms or fingers on them, the capacity of the machine can be increased up to one hundred records Obviously, an electric motor drive must be employed for the phonograph so as to do away with manual rewinding

Field Glasses that May Be Worn Like Spectacles

IF the idea of huge arenas is to be pursued in the future, with popular priced seats placed some quarter of a mile or more away from the center of interest, it stands to reason that some aid to vision will be more and more required. Field glasses are a solution of course but no one will gainsay the fact that field glasses become tiresome when held in the hands for any length of time

Why not have field glasses that may be worn like spectacles, asks an inventor and he has set to work on this idea developing the neat little field glasses shown in the accompanying view Here are diminutive field glasses, with moderate magnification, that may be adjusted to each eye in the usual way and then worn by means of a pair of bows This design does away entirely with the tiresome practice of holding the usual field glasses, and it is claimed that the lenses are better centered and therefore result in a minimum of eye fatigue

A diminutive pair of field glasses that may be worn in the same manner as spectacles

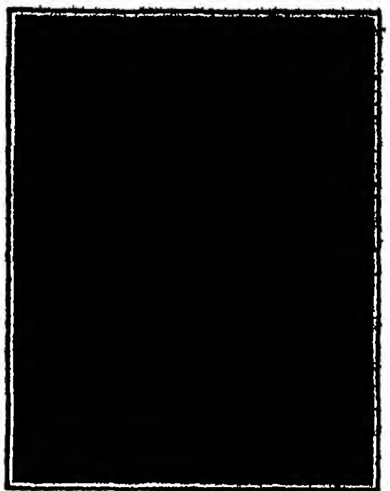
The Handy Fruit Scales

PERFORMANCE at the pail of the favorite milk cow is frequently a matter of record and why not have an accurate knowledge of the producing powers of a lemon tree? The axiomatic saying, You are being handed a lemon may be frowned upon elsewhere—but not in California

The essential distinction is revealed by numbering the trees and weighing their respective output during the harvesting season Thereby individual tree performance records are maintained over a period of successive years The numbers are painted on the tree trunk, one man being capable of numbering 175 trees a day The methods of weighing the fruit, the final test indicating inferior or drone trees that should be top-worked or eliminated varies according to the special kind of weighing apparatus designed for the purpose

The weighing equipment is a constant companion of the picker, whether it is attached to his fruit cart or strapped around his waist The formation of the picking crew is such that one man gathers the lemons of an individual tree, jotting down in black and white on his ledger the record of each tree

A novel weighing apparatus, sanctioned by the Department of Agriculture is the suspension of a spring balance from the picker by means of shoulder harness The scales are capable of weighing as much as 50 pounds Steel hooks clinched to the ropes provide an easy arrangement for hooking-up to the ends of the lemon box The weigher attaches the hooks to the ends of the box, rises in an upright position, thereby lifting the box from the ground.



An ingenious form of swivel fire-hose stand for the industrial plant

A Swivel Fire-Hose Stand for the Factory Yard

IN the yards of an oil company located in San Francisco, Calif., there may be found an ingenious type of swivel fire-hose stand which is shown in the accompanying view The device consists of a pipe extending up from the ground and protected by a concrete pyramid from being struck by passing vehicles A frame is arranged on the pipe for the purpose of carrying the neatly folded hose This frame can be turned in an entire circle and is ready at a moment's notice for action A valve is placed at the top of the pipe. Several of these swivel fire-hose stands have been placed about the yards in question and are giving entire satisfaction so it is reported

Locating the Missing Spark of the Automobile

A CHICAGO inventor has recently developed a simple device which proves unusually efficacious in locating missing spark plugs in an automobile, airplane motor boat or other power plant of the internal combustion order

In brief this device consists of a simple handle two electrodes for making the necessary contacts with the circuits to be tested, and a small variable spark gap To test a spark plug, the electrodes at the end of the handle are placed as indicated in the accompanying illustration. If the spark gap flashes intensely, it is an indication that the spark plug is missing. Various troubles may be detected by the intensity of the spark, and the gap may be varied in length to determine the setting of the spark plug points. Thus spark plugs are tested with little loss of time.

[illegible]

Getting a Line on the Higher Atmospheres

(*Continued from page 233*)

end of which is linked with the recording style. Another deviation from standard meteorographs is the employment of a single time arc for all markers. The pivots of the styles are supported by a one-piece aluminum casting and all three of the axes are at the same height. Shock-resisting qualities being imperative—in contemplation of the use of the instrument as an accompaniment of the Goddard exploring rocket—it was so designed as to reduce disturbances in the mechanical arrangement to a minimum.

To the ends of resisting ordinary stresses, strains in the support for the edges and cylindrical parts of both the case and base have been as far as possible counteracted. The former is of hard sheet aluminum .2 millimeters thick, and the cover is secured by a lock seam in stead of rivets. The sides are braced by two or more deep beads or ribs. The bottom edge is double and is fastened to the base by machine screws. A sliding door affords access to the mechanical parts, the clock drum being removed through an opening in the top of the case.

The parachute weighing 50 grams, including accessories, is but one-third of the lightest one in use as employed by Teisserenc de Bort, a Frenchman. The parachute, however, may be dispensed with for aerological errands and two pieces of brilliant silk attached to the apparatus as a substitute therefor. These strips from the silkworm factory serve the twofold purpose of retarding the descent of the equipment and in focusing attention of weather observers to the information-bearing machine having returned to earth. And in conclusion to reduce the lightest weather-recording instrument to weights and measures: Its external length is 210, height 90 and greatest width 80 millimeters. The clock drum is 80 millimeters in length, 57 millimeters in diameter and the time-scale 3 millimeters a minute. The weight of the clock and drum including a cover for the timekeeper is only 65 grams.

The Role of Chemistry

(*Continued from page 237*)

covery of petroleum that had been mixed with water in the wells. He described several of the salvage methods. Along the lines of conservation George G Brown, Jr, a graduate of New York University and an instructor in the chemical engineering department of the University of Michigan, told of his research work in connection with saving gasoline in automobile operation. His assertion that the ordinary driver of a Ford automobile could average more than thirty miles on each gallon of gasoline created such interest among the chemists that he was asked to repeat his talk before the section of petroleum chemistry. The title of his paper was "A Chemically Controlled Automobile."

The last formal exercise of the session of the society was held in the Columbia University Gymnasium, September 9th, when C. A. Browne, Chairman of the Priestley Memorial Committee, unveiled a copy of the Stuart portrait of the famous chemist. The portrait is to be given to the National Museum in Washington. It was at the grave of Priestley that two American chemists conceived the idea of the American Chemical Society. Dr Edgar F. Smith, President of the Society, in his annual address at this meeting reviewed some of the great achievements of American chemistry and said the future of the country was largely dependent upon scientific advancement and discovery.

The exposition which was held beginning September 12th in the vast Eighth [illegible] Armory in the Bronx was [illegible] and the hundreds [illegible] a liberal education in chemistry and not one you could get in the schools either. Some of the devices shown will probably be illustrated later and in last week's paper we showed the most sensational and popular exhibit—a silk purse made from a sow's ear. Truly the wonders of chemistry will never cease and chemistry now has her place not in the sun for she can make her own sun if she sees fit, but she has a place in our daily economy whether in war or peace from which she will never be unseated.

Juice of the Poppy

(*Continued from page 239*)

prohibited. The practice of eating opium stands on a very different footing and this is the common form which indulgence takes. As a vice it scarcely exists. As taken in moderation by the average Indian, opium is eaten either as a mild stimulant, as a prophylactic against malaria, for the relief of pain or in the treatment of various ailments. It is in fact a household remedy for many ills prescribed by centuries of inherited experience. Government policy is directed to prevent its misuse and check excessive consumption. The obvious method of effecting this is to enhance the price and this is being steadily done. No physical or moral degradation can be regarded as occasioned by the habit at all comparable with the use of alcohol in Europe. The mean consumption expressed to head of population in British India (including the high rate prevalent in Assam) comes to 36 grains per head per annum, and if Assam be excluded it is under 30 grains.

The Heavens in October, 1921

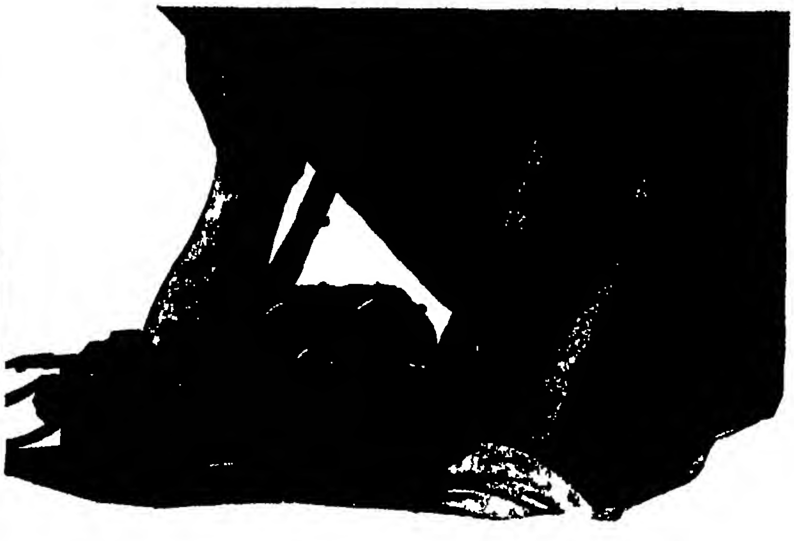
(*Continued from page 240*)

The moon is new at 7 A M on the 1st, in her first quarter at 3 P M on the 8th, full at 4 P M on the 16th, in her last quarter at 11 P M on the 23rd and new again at 7 A M on the 30th. She is nearest the earth on the 27th and farthest away on the 11th. During the month she passes near Mercury on the 3rd, Uranus on the 18th, Neptune on the 25th, Mars on the 27th, Saturn, Jupiter and Venus on the 28th and Mercury on the 30th. The triple conjunction on the 28th is notable, but is best seen from the opposite side of the earth.

As already described last month there is a total eclipse of the sun on the first day of October, which however is of little importance, the track of the shadow falling in the ocean south of Cape Horn and passing on the Antarctic continent.

Of more interest to us is a partial eclipse of the moon which occurs on the evening of the 16th. This is a large eclipse, only one-sixteenth of the moon's diameter remaining clear of the shadow. The earlier phases are invisible to us though observable in Europe and China, for the moon enters the shadow at 4 16 P M by eastern standard time. By the middle of the eclipse at 5 54 she will have risen upon the Atlantic coast, and before she quits the shadow at 7 34 she will be visible throughout the whole United States except the Pacific Coast. This is a very convenient eclipse for the amateur star gazer and is big enough so that the copper tint of the eclipsed moon illuminated by light refracted through the earth's atmosphere should be easily seen.

In conclusion it may be remarked that scattered observations still incompletely reported indicate that the bright object seen close to the sun at the Lick Observatory on August 7th was detected by at least one other astronomer, Professor Douglass in Arizona, and by an amateur, Dr Emmert, of Detroit, while a bright streak in the sky suspected to be a comet's tail, was later seen at Heidelberg. These records, to which others may later be added, make it very probable that the object was a great comet, passing very near the sun at perihelion.



Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Electrical Devices

CURRENT REGULATOR FOR ELECTRIC FURNACES.—S BURROWES, 30 McRae St., Niagara Falls, Ontario Can The invention has particular reference to a regulator adaptable to control the flow of current consumed in electric furnaces. It is an object to provide a regulator which will maintain the flow of current in an electric furnace as steady as possible, and to provide mechanism in which the length of the regulating impulse given to the control motor may be adjusted to meet the requirements of the furnace.

Of Interest to Farmers

PLANTER.—G H WRIGHT, 1925 W Pacific Ave., Spokane, Wash An object of the invention is to provide means for controlling the dropping of the seeds, which means is adjustable so as to provide for different sizes of seed and is automatic and driven by the traction of the planter over the ground. A further object is to provide means for opening and covering the seed trench The device is especially designed for garden use.

ADJUSTABLE SEAT—J P EAKIN, Box 63, Jollytown Pa This invention relates to seats for farm implements. An object is to provide a suitable mounting for a seat of the character above referred to so that the same may be adjusted for being supported in a horizontal plane when the implement with which the seat is associated is operating on an incline or on a hillside

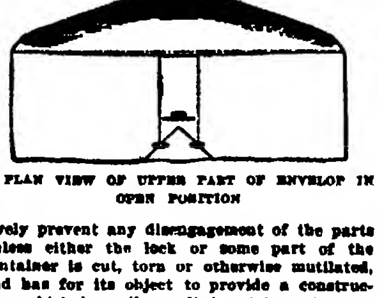
Of General Interest

APPARATUS FOR INDICATING THE CONDITION OF COAL COMBUSTION—Z. GIBSON, 7-9 Hanover St. New York, N Y Among the principal objects of the invention are to produce a continuous record of the condition of coal consumption to avoid inaccuracies in the record, to obviate inaccuracies in the measurement of gases having variable temperature, and to cool and filter the gases before the same are delivered for measurement.

FISHHOOK—A. F THORNTON, 1121 Flatbush Ave., Brooklyn N Y An object of the invention is to so construct a fishhook that no danger of the same tearing the fish's mouth exists no matter how great the pull A further object is to provide a construction which shall be extremely simple its parts being such that it may be manufactured at small expense, at the same time be strong enough to reduce the danger of breakage to a minimum.

BARREL PROTECTOR.—W F MEEK c/o Tu Tee Oil & Gas Co, Apartado, Tampico, Mexico. The invention aims to provide a device for protecting receptacles, adapted to be arranged within and extending throughout the entire length of the same, including in combination a pair of body bracing portions adapted to contact with the inner face of the receptacle and means for connecting said bracing members one to the other

LOCK FOR ENVELOPS AND OTHER CONTAINERS.—G DOUTNEY, c/o Hard & Rand, 107 Wall St, New York, N Y The invention relates to envelops and containers of all kinds, and particularly to a lock therefor which will be out of sight, and will positively prevent any disengagement of the parts unless either the lock or some part of the container is cut, torn or otherwise mutilated, and has for its object to provide a construction which is easily applied and is positive in its action either in a comparatively stiff, or in a flexible container

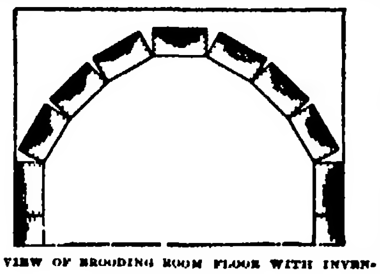


A PLAN VIEW OF UPPER PART OF ENVELOP IN OPEN POSITION

STOOL.—F P RILEY, 2408 Creston Ave. Bronx, New York, N Y The primary object of the invention is to provide a combined stool and mirror especially adapted for use by shoe salesmen, the said mirror being capable of being swung from an obscure position to a position in which it is used to display the foot and the shoe thereon the mirror will move automatically to display position

CONTAINER. — J LEVY, 2161 67th St. Brooklyn N Y An object of the invention is to provide a container in the form of a cup constructed of sheet metal formed from a single blank for the sides and a separate blank for the bottom connected to the side blank by a seam, while the side blank is seamed together in such a manner as to cause one end to project and thereby present a handle integral with the sides.

POULTRY DEVICE.—H C EVANS, c/o Craddock Terry Co Chattanooga, Tenn The invention has for its object the provision of a device adapted for use within a brooding room for preventing young chickens from crowding in the corners or at the sides of the room and thus becoming smothered or unduly heated The device comprises an inclined floor and a plurality of rollers mounted for rotary movement beneath the lower edge of the floor



A VIEW OF BROODING ROOM FLOOR WITH INVENTION APPLIED

BANK BURGLAR PROTECTIVE DEVICE —C A GUTH 652 W 43rd St. Chicago Ill. An object of the invention is to provide a device by means of which a bank cashier may instantly protect himself from an armed robber The invention consists of a movable screen which is normally out of sight but which may be instantly brought into position to screen the cage. A further object is to provide a device which is operated by an electric circuit from different points of the bank so that others may actuate the mechanism.

SELF-LINING INTERLOCKING BUILDING BLOCK—J J MEEHAN, 2700 6th St, Port Arthur, Texas. The invention relates more particularly to an interlocking building brick which will permit of the formation of strong insulated and properly lined walls without the use of skilled labor, and with or without reinforcement as may be desired In this construction painting is done away with, and the inner and outer surfaces are smooth, providing for effective decoration

HOSE COUPLING—F W BURNS, 1210 Franklin St, Johnstown, Pa. A purpose of the invention is the provision of a coupling which is of simple and efficient design and which can be readily attached to or detached from the ends of two sections of hose, and when in applied position to effectively connect the two sections in such manner as to prevent a leakage between them

BIT—H L DAUGHERTY address V Belanger & Co., 130 Osgoode St Ottawa, Canada This invention has for its object to provide a bit especially adapted for riding bridles, and wherein a bit bar is provided with a curb and cheek pieces in the form of plates extending above and below the bar, each piece having an opening at its top, and a tongue hinged to move transversely to form with the cheek piece a buckle, each cheek piece having a rosette forming a keeper below the opening

DRESSING AND DYEING MOLESKINS.—H GARBE, 115 Westminster Rd., Brooklyn N Y The invention relates to the preparation of moleskins for use in fur coats, muffs, and other wearing apparel, wherein the natural color of the moleskin is maintained and rendered permanent and skin pliable. The dyeing solution consists of the following: Logwood dye, 50 parts, sal ammoniac, 25 parts, sumac 25 parts; bluestone, 25 parts; antimony oxid, 25 parts, copperas, 50 parts. The dyeing operation lasts from ten to fifteen hours.

BALL COCK.—M H GRESSON, 217 Lafayette St., Tampa, Fla. The primary object of the invention is the arrangement and disposition of the parts with the purpose of having the valve to seat not only in the direction of flow of water but also in a downward direction so that it is capable of closing by its own weight, and will remain closed by the water pressure and its own weight as long as unaffected by the float controlled connections.

WATCH CHARM.—R. C HOMAN, Chino, Cal A purpose of this invention is to provide a watch charm including a body and a plurality of emblems detachably sustained on the body so that a person belonging to a number of lodges or societies can purchase separately any emblems and mount them on the charm body, it being the purpose to manufacture bodies and emblems separately

SPRINKLER HEAD.—W C PRETTY, Box 511 Columbus, Ohio Among the objects of the invention is to provide a sprinkler head which is so constructed as to allow of the proper spreading and falling of the water on all parts of the area allotted for fire protection Furthermore the invention allows a quicker and more efficient adjustment of the valve and prevents leakage of water from the head, the head being capable of quick assembly to facilitate installation

SAFETY OIL CAN—J D RICHEY, 209 Fancalua St., Corpus Christi, Texas. This invention has for its object to provide in an oil can mechanism for securely closing the spout to prevent waste and evaporation, the said means being in the form of a cup or container holding a definite amount of oil, as for instance enough to kindle a fire

NECK SHAVING PATTERN OR GUIDE.—W T SESSOMS, 6237 Kenwood Ave., Chicago, Ill An object of the invention is to provide a simple convenient and adjustable device by means of which one can shave his own neck, so as to give a symmetrical curve at the edge of the hair similar to that which is obtained at the hands of an expert barber The device may be adjusted for use by persons having large or small necks.

PROCESS OF PREPARING MALTED FOOD PRODUCTS—J W ALLEN, 3934 Walton Ave, Los Angeles, Cal This invention relates primarily to the curing and seasoning of meats, but may be applied to other foods, such as vegetables, meat extracts, etc, the process being economical in that it obviates the handling to which malted food products by the ordinary process are subject An object is to provide a process of preparing malted foods in which a malt flavor is imparted to the products during the curing of the same.

ADJUSTABLE PICTURE FRAME—A PETROW 82 Coso Ave., San Francisco Cal. The primary object of the invention is the provision of a picture frame of simple and inexpensive construction, which may be adjusted to receive pictures of different sizes. Another object is to provide a frame which need not be taken apart completely to effect an adjustment and which does not require particular skill to effect such adjustment.

PILLOW OR LIKE OBJECT—C S BANKS, 322 Pitkin Ave Ft Collins, Colo. The object of this invention is to provide a pillow comprising three sections, the two end sections being identical and including relatively thick portions filled with non-compressible material, and a relatively thin central section between and connected to the end sections and filled with soft yielding material The object being to provide a pillow which will be comfortable when the user is on his back or on his side.

ATTACHMENT FOR CIGARETTE HOLDERS.—W L. WALLACE, Davidson, N C An object of this invention is the provision of an attachment for a cigarette holder by means of which a cigarette holder even when burned up to the holder, may be ejected without inconvenience and securely held within the holder against accidental displacement until it is desired to eject it.

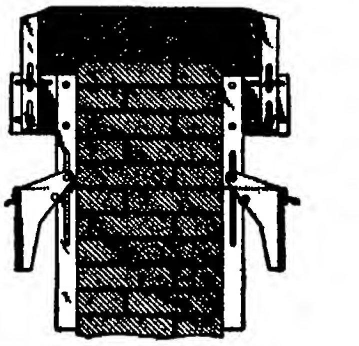
TOOTHBRUSH.—J H. BOWMAN, Box 1174, Honolulu, Territory of Hawaii. This invention has for its object the provision of means to convert a sheet of paper of suitable size into a compact form so that it may be utilized one or more times as a toothbrush, and that when it is finally formed will present serrated surfaces particularly well adapted to reach every part of the teeth Another object is to provide a simple, pliable handle on which the folded paper may be mounted.

TOOTHPICK HOLDER.—G. W. WALKER, 2207 Seminary Ave., Oakland, Cal. The invention relates to a holder having means whereby it may be attached to the end of a watch chain and carried in the vest pocket. The prime object is to provide a holder which may contain a supply of toothpicks, and is so constructed that a toothpick may be removed and inserted in an aperture comprising a handle, and thus used.

DISPLAY DEVICE.—C I OWEN, 396 E. 201st St., Yonkers, N Y The object of the invention is to provide a display device more especially designed for displaying burial and similar garments, and arranged to protect the garments against dust, to permit of conveniently changing the garments on the form, and to display the garments to the fullest advantage.

GLAZING CLIP.—H. M. LOTZ, R.F.D. 1, Box 106, Belmar, N J Among the objects of the invention is to provide a skylight or roof rail in the form of a T-beam having formed through or in the web portion thereof a series of holes or notches and with which the flexible tongue portion of a clip is adapted to engage and interlock, while the end or foot portion of the clip bears firmly against the outer surface of the glass plate.

MOLD SUPPORT—J J MILNES, 55 Clinton Ave., Port Richmond, N Y The invention relates more particularly to a bracket for supporting concrete forms. Among the objects is to provide a collapsible device especially adaptable for supporting forms to provide cappings for walls. A further object is to so construct the bracket that it is adjustable, thereby adapting itself to forms of various sizes.



A VERTICAL SECTIONAL VIEW OF WALL, SHOWING DEVICE IN USE

COVER AND SUPPORT FOR CARRIERS.—R. P ORR, 35 S Manning Blvd Albany, N. Y The invention relates to a cover construction which may be easily manipulated and which will not interfere with the action of the supporting straps. An object is the provision of a carrier and cover together with means for supporting the same, arranged to extend through the cover without interfering with the operation thereof and support the carrier from an interior point.

ALLOY—F MILLIKEN, 18th Floor, 110 William St., New York, N Y The object of the invention is to provide an alloy characterised by pronounced density and ability to withstand pressure, also to resist nitric acids, nitrate derivatives, ammonia, picric acid and other similar acids having deleterious influences when subjecting ordinary aluminum alloys to the action thereof. The alloy consists of aluminum 80-04 per cent, lead 5-10 per cent.

ENVELOP—J P DE VAUGHN, 1078 Ellicott Sq, Buffalo, N Y An object of the invention is to provide an envelop having a closing flap easily manipulated in opening and closing the same, in which the contents are securely held although the envelop is not sealed, and which may have two addresses or other inscriptions permanently applied thereto although one only at a time is visible when the envelop is in use.

SILO OR FILLING TRUNK FOR POWDER OR GRANULAR MATTER.—K. LOTZ, Darmstadt, Germany. The object of the invention is to provide an apparatus of this class from which powdered or granular matter can be discharged in a uniform flow. The apparatus comprises a trunk having a discharge at the bottom and a plurality of irregularly spaced heads for breaking up the material as it moves downward.

(Continued on page 246)

Anchoring Fly-a-way Seeds

IN neighborhoods subject to long dry spells it is an important matter to plants to get their seeds underground as soon as possible, especially if the location is windy One of the methods by which they accomplish this is by exuding a sort of natural mucilage as soon as they obtain any water A German botanist studying plants in northwest Africa, found that out of 906 varieties more than 36 per cent, 332 to be exact, are marked by this feature In studying them he found that after being wetted and then dried they adhered strongly to whatever lay beneath them, whether this was filter paper, earth, or the slide of a microscope The first rainfall, therefore, literally glues them to their places, giving them a foothold to start their struggle for existence as soon as the needed rainfall comes, even a heavy dew will sometimes suffice to liberate the "glue" This anchorage to the ground also serves the purpose of assisting the young root to make its way into the soil, as well as the sprouting plant to escape from its imprisonment within the seed A writer in the monthly supplement of the *Chemiker Zeitung* (Berlin), remarks in describing this phenomenon that the plants must ripen their seeds before the beginning of the summer drought and most of them do this, but a few kinds bloom so late that the fruit does not ripen until the beginning of the winter Others in which the fruit ripens in May or June, do not let it fall until the end of the dry season, and in a third group the fruits do not open until there comes a steady downpour, even if they have to wait a year for that blessing Tests made of 50 varieties of desert plants proved that the seeds of most of them open very shortly after they are watered, showing that the plants are ready to make use at once of the heavenly gift of moisture.

Cement-Coated Nails and Their Origin

CEMENT-COATED nails were invented by Ira Copeland, Brockton, Mass, prior to 1915, says H A Knight, a writer in a leading trade paper Prior to their being made in the United States, they were seen here only when they came in imported packages and were known as French nails. The inventor noted that the lumber in which these French nails were driven was very resinous Upon experimentation he found that when they were cleaned and driven into our native lumber they did not hold any better than American nails.

He then experimented with various combinations of vegetable gums, which resulted in a patent issued to him in May, 1887. Since Mr Copeland was a school teacher and not in a position to engage in manufacturing, he sold licenses to manufacture under his patent to about 25 concerns scattered over the United States and Canada. Only at Whitman, Mass., however, was any serious attempt made to manufacture and market this product, and this was done under Mr Copeland's observation and assistance

In the early nineties James C Pearson bought Mr Copeland's interests and recalled by purchase most of the outstanding licenses. He secured Pittsburgh manufacturers to make the nails for him, all of whom are now either out of business or incorporated in the American Steel & Wire Company

The first attempts at commercial coating were made by using a very complicated machine, also the invention of Mr Copeland, which gave slow output and inferior product as compared to that of today. Upon moving to Pittsburgh Mr Pearson simplified the process, using a simple tumbling oven, which was later developed by the leading interests in the coated nail business into efficient and speedy machines.

Many carpenters are prejudiced against the use of such nails, because they cannot place them in their mouths and because they soil the hands. In packing delicate goods there is objection sometimes lest they soil the goods. Because of their extreme holding power they are not suitable to house-finishing work or cabinet work where boards may have to be taken off for replacement or adjustment.

A cement-coated nail is of mottled appearance, with blotches of the glue-like brown coating, through which shows the steel color of the nail. The heat of the hands slightly melts the coating and makes it sticky The growth of its use has kept pace with the growth in the use of wire nails A recent adaptation was that for the wooden molds for the concrete of the Princeton stadium

There are many manufacturers of this product on a small scale in the United States. Some have attempted to use paints or varnish, but the resinous mixtures seem to have been the most successful

Approximately one tenth of the wire nails manufactured are cement-coated, according to R L Foster, president of J C Pearson & Co, Inc., Boston the largest producers of coated nails in the country Such nails have been given a shaking up in a hot tumbling barrel with a compound consisting mainly of resin from which they issue with a thin, tough coating which greatly increases their holding power The friction of the driven nail with the wood melts the cement and forms a glue, which makes fast the nail

The product is used principally in wooden packing cases of all kinds, including boxes, barrels, crates It is claimed that by their use there is less loss because of broken packages, less loss by theft because of the difficulty of prying open the cases and because of the squeak incident to the extracting of the nails It is said that but one coated nail need be used for every two plain nails.

Coloring Oranges With a Gas Engine

THE marketing of Satsuma oranges is being speeded up by an artificial process of discoloration developed by the Office of Horticultural and Pomological Investigations of the United States Department of Agriculture Laboratory tests at the Government farm, Arlington, Va, reinforced by more elaborate experiments in Baldwin County, Ala, have determined the feasibility of applying an attractive coloring to oranges by exposing the fruit to an atmosphere of gases formed by an imperfect combustion of kerosene and other petroleum products.

The Satsuma orange, strange to say, reaches its most inviting state for consumption several weeks prior to the attainment of a yellow color If permitted to remain on the tree until it assumes the characteristic hue of a ripe orange, the fruit is robbed of its fine flavor The tendency is for this variety of orange to become flat and tasteless. The time-honored habit of the buyers of oranges is to specify a fruit with a yellow color, long considered as the only sure ear mark of a ripe orange Obviously, the fruit salesman is at a disadvantage in marketing the green-colored specimens.

Hence the efforts of the Bureau of Plant Industry in devising a method of artificial discoloration, which to appearances would seem to hasten the ripening process where nature left a gap between immature coloring and premature readiness for market when judged by the juicy mixture. A gas engine in operation at the Government experiment farm in Virginia cures the skin or gives the desired yellow coloring by subjecting the fruit to an atmosphere of gases. Similar experiments in the orange groves of Alabama fortify the laboratory conclusions as to the practicability of the novel procedure. The oranges are cured in from three to five days, the products thus treated being accorded prices in excess of the uncured fruit taken from the Satsuma trees.—By *S. R. Winters*

RECENTLY PATENTED INVENTIONS

(Continued from page 244)

Hardware and Tools

FISHING TOOL.—J T MALONEY, 918 S Quaker St., Tulsa, Okla. The object of this invention is to provide a tool of the character specified for finding and removing lost bits of other tools from a well, wherein the fishing tool comprises a socket for receiving the end of a lost bit or other tool, having means for tightly gripping the lost tool to permit the same to be withdrawn

WRENCH —C A KLOPFER 214 11th Ave Asbury Park N J The invention relates to a gear drive socket wrench which can be conveniently used for removing or replacing nuts which are awkward to reach An object is to provide a socket wrench which can be operated to lock the socket against turning movement to permit the full leverage of the wrench to be employed for loosening a nut and then enable the socket to be turned by the gear driven mechanism to complete the removal of the nut.

WRENCH.—E. T KNITTER, 3582 W 67th St, Cleveland, Ohio. The invention has for its object to provide a wrench, wherein a shank is provided having a fixed jaw and a movable jaw, the movable jaw and the shank having interengaging means for locking the movable jaw in adjusted position, and wherein the shank is calibrated for cooperation with the movable jaw as an indicator to indicate the position with respect to the fixed jaw

BIT AND DRILL GUIDE —F PYRON, 315 E. 29th St., New York, N Y This invention relates to drill and bit guides adapted for cutting mortises for installing locks in doors. The device comprises a clamp to be attached to the door a drill bit support attached to the clamp and means for moving the support longitudinally and laterally with respect to the door

LOCKING BOLT —W HACKETT, 880 32nd St., Oakland, Cal. The primary object of the invention is to provide means which may be conveniently used for temporarily or permanently clamping plates or the like, the device being especially adapted in connection with ship building where it is desirable to clamp two or more plates together preparatory to riveting or otherwise fixing them together

VISE.—R. S. LIDSTONE, Box 203, Gatun, Canal Zone. An object of the invention is to provide a device having rotary motion upon a support and to provide means associated with the support for selectively preventing or permitting such rotary movement, so that the work may be rotated without removing it from the jaws of the device. A further object is to provide a device which will be simple, practical and strong

Heating and Lighting

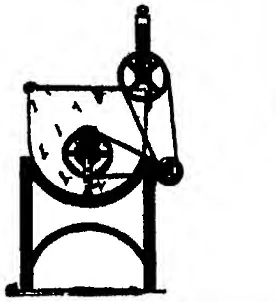
HOT AIR CANDY COOKER —ELIZABETH A. CASEY, 801 Morewood Bldg, East End, Pittsburgh, Pa. The invention particularly relates to hot air cookers capable of advantageous use in the making of candies, jellies, jams and preserves, the object being the provision of a cooker in which the heat is confined and regulated so as to bring the syrup or other material to the required high temperature in the quickest possible time and to eliminate all possibility of burning or scorching the material in course of preparation

IGNITER.—G A IVEY 1627 Carmen Ave., Chicago, Ill. This invention relates to a flash light powder igniter, particularly adapted for use by photographers. The object is to provide an igniter in which the sparks to ignite the flash powder are projected directly into the flash pan in which any possibility of premature ignition is precluded and in which all phases of the operation are completely controlled in order to provide against accident.

Machines and Mechanical Devices

CLOTH GUIDING DEVICE FOR CLOTH FINISHING MACHINES.—W A. HOGAN, 749 Patton St., Danville, Va. This invention relates generally to cloth guiding devices and more particularly to an apparatus designed to hold moving fabric out to a smooth surface and prevent wrinkling or doubling previous to its passage into the rolls of calender or other cloth finishing machines such as brushing machines and others well known in the finishing of fabrics.

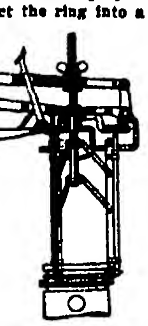
WASHING MACHINE AND GEARING FOR SAME —F H. MAYER, 254 Elati St, Denver, Colo The inventor has been granted two patents relating to the same subject matter, one has for its object to provide a washing machine with a clothes cradle made of strong wire mesh but given a corrugated shape to produce a wash-board effect, the cradle has no interior rods or projections which would tend to cause the clothes to become entangled.



ILLUSTRATING THE APPLICATION OF THE GEARING TO A WASHING MACHINE

The other invention provides for a mutilated drive gearing for oscillating the clothes cradle so as to wash the clothes and a continuous gear for revolving the cradle to expel the water from the clothes.

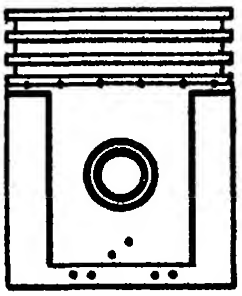
PISTON RING PLACER.—E. MCPEEK, Sardis, Ohio An object of the invention is to provide an apparatus which will expand a piston ring, hold it in proper position on a piston and eject the ring into a piston groove.



A VIEW PARTLY IN ELEVATION, BUT MAINLY IN VERTICAL LONGITUDINAL SECTION

A further object is to provide an apparatus which is capable of use in connection with any size of piston ring and which can be quickly and conveniently manipulated.

PISTON.—H W PIERCE, 53 E. Broadway, Butte, Mont. The invention relates more particularly to pistons for internal combustion engines, an object being to provide a piston



A VIEW IN SIDE ELEVATION

which is constructed mainly of aluminum, but which is reinforced by a cast iron section to take the load caused by the angularity of the connecting rod and hence insure an accurately fitting piston of long life yet mainly of aluminum.

Railways and Their Accessories

LOCOMOTIVE DRIVING BOX.—F CANNON, Hamlet, N C The invention relates generally to locomotive driving boxes, and more particularly to a driving box having for its primary object the support of a bearing brass in such manner and of such nature as to greatly outlast the usual bearing brass and render more efficient and effective service throughout its life, and provides for its ready renewal when necessary

Pertaining to Vehicles

TRACTION DEVICE —H E. HOUSTON, 801 Lee St., Wichita Falls, Texas. The invention pertains more particularly to traction devices adapted for attachment to wheels of motor vehicles to enable the wheels to obtain a better grip on soft roads, mud holes, and the like. The device may be readily attached and detached from a motor vehicle wheel, and is constructed in such manner as to be adjustable to wheels of various dimensions.

TIRE. — V. KUBELKA, 1317 Bleecker St., Brooklyn, N. Y. The principal object of the invention is to provide a resilient filler for tire shoes which will obviate the use of pneumatic tires on vehicles of all descriptions. A further object is to provide a puncture-proof construction which may be readily installed which will be strong and durable in use and which will greatly prolong the life of the tire shoe.

FRICTION CLUTCH.—A. C. JACOBI, address A. E. Bessey, Sunnyvale, Cal. The invention more particularly relates to an automatic one-way friction clutch, which while adapted for use on any machines or vehicles involving a drive element, is especially adapted for use in cranking automobiles. An object is to provide a friction clutch which will instantly cause the driven element to be engaged in the clutching movement and which will automatically release the driven element.

ANTI-SKID DEVICE.—V KUBELKA, 30 McDougal St., Brooklyn, N Y This invention relates to that form of anti-skid device commonly known as a tire chain, an object being to provide a form of tread member associated with a pair of annular chains. A further object is to provide a device which will be simple and practical in construction, strong in use, and a device which may be quickly applied or removed.

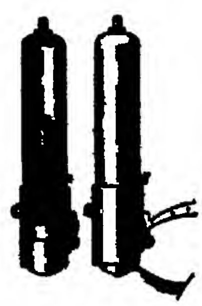
LICENSE PLATE HOLDER.—H. BREWSTER, 69 5th Ave., New York, N Y The invention relates to plate holders usually positioned upon the rear parts of automobiles. An object is to provide a plate holder in which the plate may be so positioned that it may be sealed so as to prevent unauthorized removal. A further object is to provide means by which the license number may be readily read after dark, and may also serve to indicate the direction in which the vehicle is about to turn.

DUMP CAR LATCH —W J RUNDLE, 137 Wing Ave., Meaderville, Mont. An object of this invention is to provide a locking mechanism for dump cars which is located entirely under and within the car A further object is to provide a latch mechanism which will be comparatively cheap to manufacture, which may be readily installed and which will be practical and durable in use.

DEMOUNTABLE RIM.—H M HOWELL, Monroe, La. The invention more particularly relates to a rim of the type employing a removable outer tire retaining flange. An important object is to provide fastening means for the outer removable tire retaining flange in which the fastening action is equally and evenly distributed along the entire circumference to provide the greatest strength and prevent distortion of the various parts.

RESILIENT TIRE.—W B. SHAW, c/o E. B. L. Co., 43rd St and 8th Ave, New York, N Y The invention has reference to a resilient member adapted to be placed on the inside of a tire casing An object is to provide a resilient filler for a rubber casing which will be puncture proof and which will be fully equivalent to a pneumatic cushion when travelling

SHOCK ABSORBER.—L. F FITZGERALD, Box 156, Oilfields, Cal. This invention has for its object to provide a device of the character specified adapted for use with motor vehicles and designed to act as a resilient



A LONGITUDINAL SECTION AND FRONT VIEW

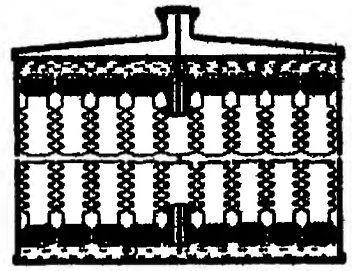
load carrier and as a snubber for cushioning the recoil. The device is of cylindrical form, in two sections within which are arranged a plunger and coil spring. The valve permits the free entrance of air, but restricts the outward flow of air when the plunger moves toward the valve.

AUTO TIRE LOCK.—W A. [illegible], 673 Milwaukee Ave., Chicago, Ill. An object of the invention is to provide a simple, relatively inexpensive device for securing an automobile tire in adjusted position on a tire-carrier. A further object is to provide a device that has members adapted to encircle the rim of a tire carrier, and is provided with a [illegible] locking mechanism, [illegible] [illegible] removal of the tire cannot be accomplished without breaking the locking device.

CARBURETOR LOCK.—C. E. [illegible], 2104 W. 2nd St., Dayton, Ohio. The special object of the invention is to provide a lock designed to cut off the supply of gasoline or other liquid fuel from the needle valve, thereby preventing running of the engine by unauthorized persons. Another object is to permit of conveniently applying the lock to carburetors as now generally constructed.

DETACHABLE TRUCK BODY FOR AUTOMOBILES.—J. E. SHANNON, address Fred Fair, Atty., Marshall, Mo. This invention has for its object to provide a truck body which may be easily and quickly attached to or detached from a Ford runabout, for instance, and wherein means are provided for reinforcing the springs of the vehicle, said means being arranged between the rear axle and the detachable truck body.

RADIATOR.—A. NIMMS, 794 Knickerbocker Ave., Brooklyn, N. Y. The invention relates to liquid cooling devices, and is particularly adapted for use as a radiator for automobiles, but may be used wherever it is desirable to



A VIEW PARTLY IN SECTION, SHOWING THE ARRANGEMENT OF TUBES

cool a circulating liquid. Among the objects is to provide a radiator having its parts so constructed as to bring the circulating fluid in contact with a large exposed surface whereby the liquid may be effectively cooled, in a limited space.

RESILIENT WHEEL.— A. N Y. MARTINEZ, P O Box 668, San Juan, Porto Rico, An object of this invention is to provide a construction wherein resiliency is secured through the use of compressed air operating at the end of reciprocating spokes. Another object is to provide a comparatively stiff rim having hinged spokes and means associated with the hub which will take up the shocks and resiliently limit the swinging movement of the spokes and the movement of the rim.

GEARING FOR VEHICLE SIGNALS.—H. C CARSON, 3531 Olivette Ave., Station L, Cincinnati, Ohio. An important object of the invention is to provide a vehicle signal for street railway cars and automobiles, which is simple and durable in construction, and which may be controlled by the operator without detracting from his capacity to control the vehicle, and which will effectively advise adjacent vehicles of intended change.

Designs

DESIGN FOR A TOY HORSE AND JOCKEY.—E. MULRONEY, address Stewart Hale, 229 Columbus Ave., New York, N Y.

DESIGN FOR A RADIATOR CAP ORNAMENT.—L. E. WOODARD, 10 S. Terrace Ave., Mount Vernon, N Y.

DESIGN FOR A DOLL.—E. MALAVARCA, 331 S. 7th St., Newark, N. J. The inventor has been granted two patents on doll designs.

DESIGN FOR A SETTING FOR PRECIOUS STONES.—H. BERSLAVSKY, 41 Maiden Lane, New York, N Y

Showing the Earth's Movement

IT is commonly supposed that it is not possible to demonstrate the movement of the earth without elaborate apparatus This is very far from being the case as a simple device will indicate the earth's motion

In the first place select a room that is fairly free from vibration Then obtain a good-sized bowl or tub a foot or more in diameter and rather deep and nearly fill it with water Place this on the floor of the room in such a position that it need not be disturbed for some hours Get some finely powdered resin and sprinkle a coating of this on the surface of the water Any fine substance that would float and not be dissolved for some hours would do as well Next secure a little coal dust and sprinkle some on the top of the resin doing this in a straight line from the center to the circumference Carry this line up over the rim of the bowl and make it broad enough to be clearly seen—say about an inch in width

The bowl may now be left for several hours at the end of which time it will be noticed that an interesting thing has happened It will be seen that the line on the surface of the water has changed its position and that it no longer meets that which runs up over the rim of the bowl. As a matter of fact the black line on the surface of the water has swept around from east to west.

What has happened is this The water in the bowl has stood still throughout the time which it has been left while the vessel itself has been carried around by the motion of the earth from west to east Another way of putting it is that the earth has swung around through a considerable arc from west to east leaving the water quite stationary —By *S Leonard Bastin*

New Cold Method of Making Porcelain

FOR hundreds of years the firing of porcelain has been a *sine qua non* in its manufacture Word has just come from Germany that a Jena engineer named Menkel has invented a process by which the ware can be completed without firing although it exhibits all the desirable quality of porcelain which has passed through the kiln The chief constituent is kaolin as usual but this is mixed with various other materials and a special binder to form a porcelain like mass. The hardening process is a secret but we are assured the finished product is not at all inferior to the kiln baked ware Painting is unnecessary since various tints and colors are imparted by the admixture of mineral colors The articles made of this unfired porcelain leave the molds without trouble The material is especially suited for the making of buttons which closely resemble those made of vegetable ivory It can also be used for making insulators, pipes ornaments etc

Fertilizers from the Mud of the Nile

FERTILIZER manufacturers and others are constantly looking for potassium but its recovery from the sudd or mud of the Nile River in Egypt is a novel suggestion. It is only a new suggestion for the use of this material which has had various schemes proposed for its disposal The new scheme of recovering potash from it comes from an Englishman

Starting from the basis that one ton of dry sudd contains about one-fifth of the thermal energy in a ton of coal together with about 45 pounds of potassium salts, he would in one process burn the sudd in a gas-producer plant. The gas would drive a gas engine and dynamo, and the current generated would be used to electrolyse the potash salts obtained by lixiviation of the ashes for the production of hydroxide, or to make nitric acid from the air, the acid being then allowed to

react with the salts for the formation of nitrate.

In another process he would burn the sudd to charcoal in an oven heated by the sudd, and use this charcoal for the manufacture of cyanide, from which he would obtain nitric acid, via ammonia, which again could be combined with the potash salts to form nitrates. He states that this sudd charcoal is free from sulfur, and that with it, owing partly to its physical condition and partly to the contained alkali, the reaction proceeds rapidly at much more economical temperatures than with coal or coke, which require high temperatures.

French Utilization of Fish to Replace Meat

PRICES for meat in France have become so high, reports the Commercial Attaché at Paris, that many people have been forced to discontinue purchasing Indications are that the situation will become worse during the winter Frozen meat now costs almost as much as fresh meat. This has led to a revival of the campaign in favor of the consumption of fish to replace meat. Much has been said and written about what should be done in this connection, and the result has been a certain increase in the cold storage and transportation facilities to handle shipments of fish to interior cities.

The Association Française du Froid has undertaken vigorous propaganda work in order to bring to the attention of the public the necessity for a wider application of refrigeration in the handling of fish It is pointed out that France will have to face a deficit of 300,000 or 400,000 tons of meat per year for some years to come This deficit must be filled by imports of frozen meat or by the utilization of fish

It is estimated that 30 to 35 per cent of the fish brought to French ports does not find its way to the cusomers, being spoiled for lack of refrigeration

Plans have been made at Lorient for a demonstration favoring the consumption of fish at which the Undersecretary of State for the Merchant Marine will be present. Models of fishing vessels equipped with motors, cold-storage cars, and in fact everything connected with the catching and distribution of fish will be shown

The Government has interested itself very much in the matter of distribution of fish to the consumers.

What Has Been Said About Einstein

IN order to have *position* in a manifold one of whose dimensions is time, a thing must have position in time—it may not merely exist but it must happen—it must cease to be a thing and be an event. For the most part Dr Slosson escapes confusion of this sort, or at least does not get too explicitly tangled up in the web of time and space, but when he lists as typical elements in the space-time manifold "your pencil, the discovery of America, the sun and next Friday," he allows the popular style to run away with him and get him badly bunkered. The mathematically inclined reader will recognise readily that only one of these items is really an event, corresponding, in the space-time manifold, with the point in the Euclidean geometry of three dimensions that we learn in school. For the sun and the pencil possess *extension* in time rather than mere *position* therein, just as a line possesses extension in one of the three dimensions of space and position in the other two. So the sun and the pencil, if for the sake of argument we assign them position rather than extension in the three dimensions of space, correspond to the line in ordinary space—they are in fact lines extending in the time direction; while next Friday, possessing extension in three dimensions of space (it is Friday everywhere, within reasonable limits) and in the one dimension of time, actually corresponds to a complete figure like a cube, sphere, cylinder, etc., of three dimensions in three-space. Indeed, to the non-mathematical mind it must seem altogether extraordinary that, from the viewpoint of the four-dimensional geometer of space-time, the act of dropping a pencil on the floor or of looking at the sun represents a configuration of more elementary character than the pencil or the sun itself—a configuration possessing only position in the time dimension, rather than extension, and so on the level of a point rather than of a line.

NEW BOOKS, ETC.

AN OUTLINE OF PHYSICS. By L. Southerns, M.A., B.Sc. New York E. P Dutton and Company. 8vo., 202 pp.; illustrated.

Unusual in arrangement, this text aims at inspiring keenness in the student, imparting solid instruction in the subject, and presenting matter of use in his future. It begins by meeting the student on his own ground by impressing upon him the utility of the instruction. The newer knowledge is embodied in the course itself, and the plans of study inculcate real working ideas.

THE MANAGEMENT AND THE WORKER. By George F Johnson and others. New York and Chicago A. W Shaw Company, 1920 8vo, 228 pp, illustrated

Manufacturers, factory executives and managers will find suggestions of timely help in this volume in which the experiences of well-known manufacturing firms are narrated by men identified with the firms' successes. The contributions tell how to build up "a sea-worthy labor policy," give examples of "personal" management, describe the "house and senate" plan, explain the Whitley report, and treat in detail all questions of labor routine.

MECHANICAL DRAWING By Franklin D Jones. New York The Industrial Press, 1920. 8vo, 342 pp; illustrated.

This new work is distinguished from ordinary texts on the subject by its emphasis on the actual methods of up-to-date drafting rooms in machine building plants. Origination and development of design, in distinction from the mere representation of it by a drawing, is a matter upon which great stress is laid The treatise will greatly advantage the student in the school and the beginner in the shop, enabling them to grasp the relative practical importance of elements and details.

FILES AND FILING. By Ch. Fremont Translated by George Taylor. New York Isaac Pitman and Sons, 1920. 4to, 148 pp, illustrated.

Anyone interested in the technology of file-making will appreciate this authorised translation of M. Fremont's basic work by an English expert. The versatility and originality of the treatise is faithfully reflected in the translation. The origin and evolution of the file, cuts, tests, and uses, are set forth instructively and suggestively, with illustrations supplied from the rich collection of the author

KEPLER. By Walter W Bryant. New York The Macmillan Company, 1920. 12mo, 62 pp.; portrait.

In the entertaining style characteristic of the "Pioneers of Progress" series, this compact biography places before us the pre-Kepler astronomy, delineates Kepler's early life, shows his indebtedness to Tycho Brahe's observations, cites his laws, and summarises his closing years. The usual appendices of dates and bibliography are to be found.

THE STEAM RAILWAY LOCOMOTIVE. By H. L. Ahrons, M.I.Mech.E., New York: Isaac Pitman and Sons. 16mo.; 114 pp., 26 illustrations.

In the small space at his command the author has by scrupulous selection and strict economy of words given the student clear descriptions of British locomotive types, mechanisms and valve gears, carriages and tenders. Compounding and superheating are discussed, and often the reasons leading to the adoption of the principal parts that make up the locomotive are given.

JOHN DALTON. By L. J Neville-Polley, B.Sc. New York: The Macmillan Company, 1920. 12mo.; 63 pp.; portrait.

A brief but satisfying summary of the life and work of the great English chemist. It sketches the evolution of the atomic theory, follows Dalton in other important investigations, and has a table of dates and a bibliography.

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SCIENTIFIC AMERICAN

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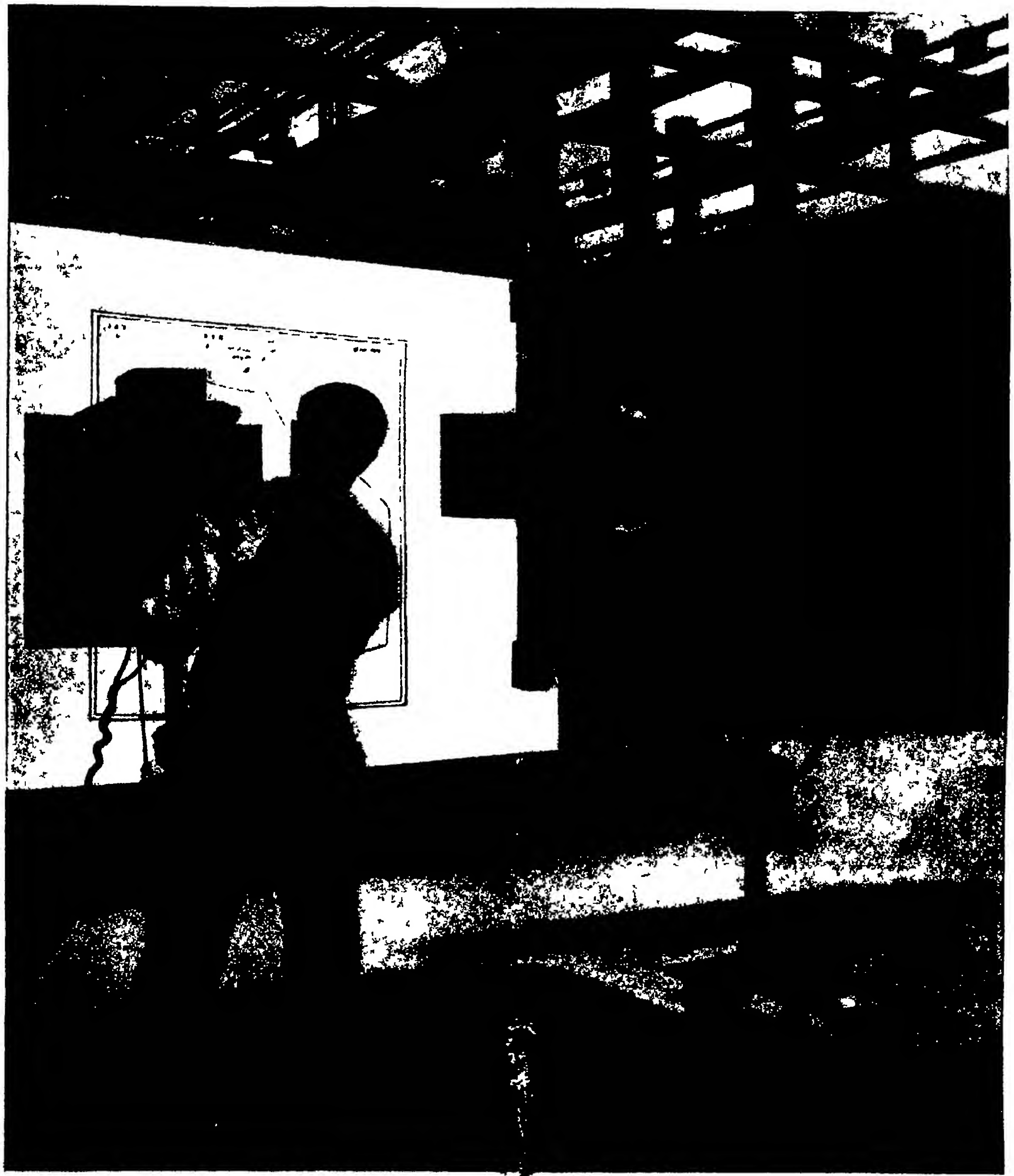
INDUSTRY · SCIENCE · INVENTION · MECHANICS



OPERATING A HUGE CAMERA IN THE REPRODUCTION OF MAPS.—[See page 253]

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Disarmament and Pacifism

THERE is a minority—a very small minority—among us which looks with disfavor upon the disarmament conference which has been called by President Harding. The attitude of these gentlemen ranges from a mirthful skepticism to bitter opposition, an opposition which is none the less fierce because it is of necessity suppressed or mentioned in most guarded terms. The principal charge brought against the whole idea of disarmament is that it has been brought about by the persistent effort of the pacifist.

Now, we have given much thought and investigation to this matter, and we are convinced that while the out-and-out pacifist is naturally in favor of the conference, these extremists represent only a very small minority among that all-but unanimous majority which has welcomed President Harding's action in the belief that it will result in untold benefit to humanity.

The out-and-out pacifist is a man whose mental processes are badly twisted. Not only is his logic out of balance, but his vision is so limited that his mind is never presented with more than a fraction of the facts upon which to base his conclusions. Instead of looking out upon the world with the full angle of vision intended by his Creator, in which he can see things in their relative proportions, he looks through a telescope, sees one object at a time and forgets that he is not looking at the whole world, but only a very small portion of it.

Peace? Certainly we all of us are in favor of peace, but we want a peace based upon law and founded upon a just regard not only for the rights of other people, but for our own rights. The complete abolition of armaments demanded by the pacifist would be the greatest possible inducement to disorder. The soldier and the sailor are merely the policemen of the nation. What would become of our rights and our property if we disbanded all the police forces of our great cities? If the fabled millennium should ever come, a police-less, army-less and navy-less world would be possible—but never till then. Now, as our readers well know, the SCIENTIFIC AMERICAN is in favor of a judiciously regulated disarmament. Not of the complete abolition of arms, but of a regulated disarmament, which shall cut out crazy competition and lead to the adjustment of a nation's naval and military strength in accordance with the existing and the probable future international conditions. That is a very different thing from pacifism. Pacifism is a peril to the future security of nations. Regulated armament by agreement among the nations will conduce to national safety, peace and well-being.

The spirit of the forthcoming conference will be determined very largely by the spirit in which we enter it, and the attitude which we assume toward the nations which we have invited to meet us around the table. Because of the unique position in which the world war has left us, our influence at the conference is bound to be predominant. It is *our* conference, called by our President, for the purpose of settling certain outstanding and very disturbing international questions, mainly in the Pacific. If we enter that conference with the conviction that the rest of the world is prepared to be just as honorable, just as fair, just as frank as ourselves, we shall give a tone to the whole series of discussions which will carry them through to a brilliant accomplishment. It should be for us to remember that the world which we have invited to meet us is a broken world, a world that is very sick and wounded almost to death. Our guests will enter the conference bearing a crushing load, imposed by their naval and military armament, and we firmly believe that there is not one of them but will come to the conference eager to have that burden lightened as much as may be humanly possible.

The spirit of the conference will depend very largely, also, upon the attitude of the naval and military officers who will advise the conferees and upon whether or not they give loyal support to the President, the Commander-in-Chief of both the Army and the Navy, in his noble effort to assist the nations to adjust their outstanding problems and throw off the crushing burden of overdeveloped armament. Such an attitude will go a long way toward securing the desired results. As regards the press, it is to be hoped that journalists and reporters, not merely of this country but of all the countries concerned, will realize the need for great caution in discussing the deliberations of the conference. A consistently friendly attitude and a determination to avoid the sensational and the disturbing, and to record the doings of the conference with the most literal fidelity to the facts, will go far toward making it a brilliant success and a notable landmark not merely in our national history, but in the whole progress of civilization.

The Technique of Road Repairing

THOSE of us who have traveled over the fine highways of Europe cannot have failed to notice, at intervals along the roadside, men who were engaged in breaking up stones to a size suitable for road making. In addition to his pile of broken stones, each man would have another pile of sand or other road-mending material. His equipment would include a wheelbarrow, a shovel and a pick axe. Occasionally the traveler will come across a man who is patrolling the road and looking for the first indication of wear. He is not long in finding what he is looking for. The incipient breakdown of the road *may* be very insignificant, possibly it will be merely a small pool of water left by a passing shower, which, to his experienced eye, is an indication that a slight deterioration of the roadway has set in at that point. With his pickaxe he carefully breaks [illegible] surface and fills in the depression with [illegible] broken stone or gravel, smoothing over [illegible] surface and leaving the passing traffic to compact the newly laid material.

Although these operations are very simple, they exemplify that system of careful detailed supervision and constant repair to which the main roads of Europe owe their very fine condition. Long experience has taught these roadmakers that this careful supervision, this ceaseless vigilance, this early detection and instant repair of the very [illegible] evidences of disintegration, constitute the only [illegible]cable method of keeping a road in permanent, first-class condition.

Our highway commissions should consider the practice of the railroads, where a complete organization is maintained for the upkeep of the track, with section gangs, foremen, superintendents, engineers and so on, up to one man upon whose shoulders rests the ultimate authority and responsibility for the whole system. Only by such methods can our rapidly growing network of highways be economically and permanently maintained.

Here is a lesson which we may well lay to heart. Too often our methods of road maintenance are as different from those followed in the older countries as could well be. Consequently our newly built macadam and gravel roads soon fall into that state of chronic disrepair which still characterizes so large a part of our highway mileage. It will be understood, *of course*, that the above is not written with reference to the best of our concrete and Tarvia roadbeds, which have reached such a point of excellence that, except under very heavy motor truck traffic, they are not subject to a rapid breakdown. However, on our very finest roads of this class it would be advisable to maintain a system of rigid inspection, and see to it that any spot where weakness develops is at once restored.

Our plea is on behalf of the grade of roads which is intermediate between a concrete road and the simplest country road. Upon these the European system of ceaseless patrol and repair could be introduced, with a vast saving of public funds and with enormous advantage to the traveling public. Too often, after building a stretch of highway, the road is left to the mercy of the elements and the unending wear and tear of traffic. Instead of patrolling the new roadway with men who are equipped for the repair of any incipient breakdown, we allow the surface to be wrecked by constant traffic, and only when the road has been so badly wrecked as to be unusable do we begin to think about repairs. These are carried out in our usual wholesale fashion; the traffic for the time being is completely disorganized; and when the repair job has been done, the road is once more left to undergo the old routine of destruction.

The Source of Inspiration

THERE must be readers to whom the psychology of the editorial page has at one time or another presented an interesting problem. When the "ZR2" falls into the river and the calamity is followed by a denunciation or a defense of the dirigible as opposed to the airplane, or a critical analysis of the structural features of this particular craft, or a general discussion of the scientific spirit of investigation which gets the most out of such a disaster as opposed to the layman's inclination toward mere panic, it is obvious where to look for the source of the editor's inspiration. Current events and timely topics, which provide the entire supply of ideas for the editorial writer of the daily newspaper, play in the life of the magazine editor a part merely less inclusive. They must necessarily provide, to everyone who writes, a goodly part of the ideas that are necessary before one can go into executive session with pen or typewriter.

But the weekly and even more the monthly sheet has to exercise discretion in its choice of "current" topics for editorial discussion, for the majority of such topics do not remain current and alive for a period corresponding to that consumed between the editing and the appearance of such a sheet. In direct proportion to the length of this period, it is necessary for the editor to turn away from immediate current events and seek inspiration elsewhere. Where does he get it? Why do we find in one issue a more or less humorous discussion, say, of the current vogue in soap advertising, while the next is featured by a serious diatribe upon present tendencies in battleship design? Why is this week's issue marked by a complaint against the too free use of alarming danger signs at points on our highways where only one bent on suicide could achieve an accident, and next week's by a hearty endorsement of the tendencies and achievements of modern electrical research?

The thoughtful reader must long since have reached the conclusion that the editorial page represents more or less a reflection of the editor's experience from day to day and from week to week. This would have been strictly true a century, perhaps even a quarter century, ago; today it is not strictly accurate. The mail brings into the modern editorial sanctum the press-agented epitome of the daily experiences of thousands of other people, who are for some reason interested in getting before the public those experiences, the views to which they have led, or the results which they have brought out. But this does not change the argument, really; it merely multiplies the editor by ten or a hundred or a thousand.

Ultimately the subject for editorial discussion must come out of the editorial mind, or out of some mind that has impressed its condition upon the editor's. The things that are uppermost in this mind are the things that come most easily to the surface and boil off in the shape of "copy." The philosophical discussion of soap advertisements can come only from one who has read a few soap advertisements with a seeing eye, an interested and inquiring mind. The harangue on the battleship of yesterday, today and tomorrow can come only from one who knows something about battleships, cares something about battleships, and has had battleships presented to his attention at some time in the immediate present. The expression of disgust at the manner of placarding our highways can only come from one who has very recently slowed to a snail's pace, in anticipation of a curve or a hill or a railroad crossing on which [illegible] concealed, only to find that he has been deceived.

And so it goes. Whenever you read an editorial that is more or less in the nature of an essay, more or less dissociated from what the news columns have put before you recently, you may be sure that the editor's daily life is peeping out at you, or at least that someone's else daily life is revealed through the agency of the editor's mail basket.

Electricity

A New Sign Lamp, especially intended for electric sign work, has just made its appearance. This 10-watt clear nitrogen-filled lamp serves well its intended purpose, so we are informed. It is a blue-glass lamp, and is a very decided improvement over the usual lamp employed for sign purposes, inasmuch as it gives a dazzling blue-white light with a minimum consumption of current.

Concentrated Heat.—Electric heating is gaining ground steadily, not so much in the home as in the industries, where concentrated heat is required. In fact, there is no other form of heat that can be applied with the preciseness of electric heat, and localized heating of parts of machines and equipment is fast come to be an almost exclusively electrical field. Several of the large electric companies are now making heating units for localized heat, and the consequence of such concentrated heat is an economical use of electric current.

Induction Motor with Double-Cage Rotor.—We learn from the *Elektro-technische Zeitschrift* that a Cologne firm has placed on the market a double motor with two distinct stators and two cage armatures with copper rods going through both motors, connected in the middle by two high-resistance alloy strips. The two motors are incased in a single shell casting which contains an entrance and an exit flange for cooling air, the rods between the two armatures acting as an excellent air impeller. On top of the motor is mounted a controller switch with seven points, permitting as many economical speeds and torques, without the use of any resistance, by simple combinations of the two stators in delta-star series and parallel. Torque, efficiency and speed curves of this interesting motor are given.

Electric Cannon.—A great variety of electric cannon, based upon electromagnetic principles, ejecting a steel shell through one or more solenoids, have been developed from time to time but with no practical results. A French engineer, Fauchon-Villeplee, has worked out a new type of electric cannon which is described in *Revue Generale de l'Electricite*. The basic principle of the new gun is the fact that a current-carrying movable conductor will travel across a strong magnetic field. The author built during the war a model of such a gun, which shot a 50-gram projectile at a muzzle velocity of 200 meters, piercing easily a large hard-wood block The author directs attention to the fact that because the gun windings are used for only a fraction of a second, enormous amounts of current may be used—of the order of 100,000 amperes and over—and supplied by a flywheel dynamo or a storage battery

Bringing the Lamp to the Cleaner.—The best lamp made soon loses its efficiency if it is not cleaned at frequent intervals. Hence one of the regular jobs about any industrial plant that has any pretensions to efficient operation, is to clean the lamps and reflectors at regular intervals. In order to simplify this work, there has lately been placed on the market a safety disconnecting hanger, as it is called, which enables high lamps to be lowered away from electrical contact and dangerous moving machinery for cleaning and renewals. With this device in use one man can do the work of three in keeping the fixtures clean and helping the many large industrial lamps to perform the duty for which they were designed. The safety disconnecting hanger holds the lamp in place, but for purposes of cleaning or lamp renewal the reflector and socket, disconnecting automatically from the source of current, can be lowered by releasing a conveniently located chain.

New York-Chicago Telephone Cable.—The installation of an important aerial telephone cable between New York and Chicago is rapidly progressing, the American Telephone and Telegraph Company reporting that the New York-Pittsburgh section will be ready for service the latter part of this year This long cable has not been made possible by only one or two developments, but by the coordination of diverse forms of apparatus and equipment. For instance, continues *Electrical World*, besides the vacuum tube and loading coil, which have furnished great help in the development, there have been the quadded cable phantom, repeating coils, two-wire and four-wire repeater circuits, new telephone signaling and telegraph systems, composite sets permitting simultaneous telephone and telegraph messages and special types of aerial construction. The cable used in this line will provide 150 to 300 telephone circuits and 175 to 200 telegraph circuits, or the equivalent of eight open-wire pole lines. The project is particularly interesting in view of the rugged country traversed and the construction methods required.

Science

The Speed of Glaciers.—Studying Alaskan glaciers, Prof W S. Cooper finds that Muir Glacier has receded 60 miles in the last 127 years.

An Old Temple.—At Sicyon, near Corinth, the foundations of a great Doric temple, probably dedicated to Artemis, have been uncovered.

Free Course in Shoemaking.—The New York Board of Education offers a free, practical course in the manufacture of boots and shoes to boys over 14 years of age.

Farewell to Fairy Stories.—A Bolshevik decree forbids mention of fairies, angels and devils in books for children. Scientists take the place of the angels, and "princely heroes" are painted as oppressors of the poor

Hot-Headed Londoners.—A thermometer, suspended for ten minutes inside the conventional silk hat of a London pedestrian, registered 107 degrees. The Londoner still clings to these heat-traps and pays in discomfort for his pride.

Guns Aid Antiquarians.—The concussion of anti-aircraft guns cracked the plaster of a font in a church near Sittingbourne, England, revealing an inner font of lead in fine preservation, an example of 12th-century continental workmanship.

World's Shorthand Champion.—The world sees its youngest champion shorthand writer in Albert Schneider, 20 years old, of New York. He wrote 175 words a minute without a single error, 200 words a minute with 12 errors, 240 words with 22 errors, and 280 words with 44 mistakes.

Sealing Fruit with Gummed Paper.—When gummed paper tape is used to seal fibre containers in which apples, melons, peaches, and citrous and other fruits are shipped, these are kept in a fresh condition for a much longer time, the actual extension of time depending on the kind of fruit. This was determined by experiments in car lot shipments.

Alpine Accidents.—From April 1st to mid-August, in North Tirol, 28 climbers lost their lives and 76 suffered severe injuries. Prominent names are among the killed and missing. Three men ascending the Dent du Midi were struck by a huge falling boulder, one was killed, another pinned down by the leg, the third secured help after five hours, it was then found necessary to blast the boulder to release the victim, which took another two hours.

Rumford Fund Awards.—The Proceedings of the American Academy of Arts and Sciences (No 10, Vol 56) has a complete list of its awards and grants from the Rumford Fund for Research in Light and Heat Forms. The first award went to Robert Hare for his oxyhydrogen blowpipe in 1839, and the latest to Irving Langmuir for his researches in thermionic phenomena, in 1920. Between these early and late awards many illustrious names appear

Sunlight Ages Clothes.—Rain, air, mechanical strain and bacterial action all shorten the life of clothing, but sunlight is its worst enemy. Cotton and linen are more resistant to the deleterious rays than silk and wool, dark fabrics escape longer than light ones, and coarse material longer than fine. On the other hand, dyes fade more rapidly in cotton than in wool Clothes should be brushed frequently, and when not in use should be put away in a dark place.

The Mechanism of Glaciers.—In tunneling through glaciers during the Alpine operations of the war, opportunity was offered for observations of inner structure and movements. In shallow cuttings, characteristics only to be expected at much greater depths were found. The alternation of lighter and denser layers cannot here be caused by pressure, but must be a primary, sedimentary formation. Interior crevasses often ended in a plane of stratification, thus pointing to the importance of such planes in the glacier mechanism.

Medical Fees Restricted.—The Johns Hopkins Hospital has limited its charge for medical attention to $35 per week and has made $1000 the maximum charge for an operation. Hitherto the medico has favored the poor and recouped from the wealthy, a certain clinic, for example, is said to ascertain the patient's income and tax it 10 per cent. Objectors to the new plan believe it will result in higher charges to the poor Dean Williams makes a statement defending the Hospital's course, pointing out that it is a philanthropic educational institution, that the new rules stress the altruistic ideal of the profession; and that, since but 1-5 of its 900 beds will be available for private patients, there is no danger of the thrifty rich excluding the poor Moreover the authorities may, at their discretion, allow a higher remuneration than the new rules provide for.

Wild Life

The John Burroughs Memorial Association has been organized to protect his homes and camps and to preserve them, with their wild life, for future generations.

A Golf Story from Canada.—Ontario squirrels are apparently mistaking golf balls for nuts. A Carleton Place golfer found 41 balls in one hollow tree, and further search of the squirrels' caches revealed 50 more lost balls.

A Pigeon's Record Flight.—A pigeon from the Government's loft at Beltsville, Md, delivered a message from Mayor Thompson, of Chicago, to President Harding in 16 hours actual flying time for the 614½ miles, breaking all former records.

Steel Jaws Are Cruel.—One-fourth of the animals caught by steel traps are worthless, 15 per cent escape by chewing off a leg. Many are eaten by other animals, all suffer lingering torture The American Humane Society offers prizes aggregating $800 for the best essays acquainting the public with this cruelty and showing how it may be remedied

Life Histories of Fishes.—In spite of a depletion of 36 per cent in his technical staff, the Commissioner of Fisheries reports notable progress in biological investigation Much has been added to our knowledge of the lives and migrations of the Pacific coast salmon, of the paddlefish and smelts, of the whitefish and ciscoes of the Great Lakes, and of diseases of fishes in the St Lawrence.

Snakes as Source of Profit.—Near Brownsville, Texas, W A. King conducts one of the largest snake farms in the world, with a hundred hatchers constantly employed The farm supplies specimens to museums and poison to chemists and medical men Each rattler yields about a fourth of a tumblerful of the deadly green liquid. Snake oil, as a remedy for rheumatism, brings a good price, and hides and rattles are used in the manufacture of novelties.

Jersey Mosquitoes.—The annual report of the State Department of Conservation and Development declares that extermination of the mosquito would, in 20 years, add $500,000,000 to the State's industrial values, and that a 5-year campaign costing less than a million would eliminate the pest for all time Disease-bearing mosquitoes, local and not numerous, are readily controlled by local efforts. On the present scale of appropriations, it will require 15 years to banish this pest

Campaign Against Rabbits.—Since January, Grant county, Washington, has held 25 rabbit drives with a total of 98,050 killed The rabbits ate up 4,000 acres of grain this summer at Moses Lake In six months the Department of Agriculture distributed, free, 600 ounces of strychnine, and one ounce of this poison destroyed 1329 rabbits in a single field There is a movement for winter shipment of frozen rabbits to cities for free distribution among the poor

Zebu on the Paris Menu.—"Peau de zebu" is French slang for "worthless." Now Parisians have for some time been eating zebu, or Indian bullock, without knowing it In their search for cheap meat the authorities discovered that the flesh of the zebu loses its stringy character and flat taste when the animals are reared in the French colony of Madagascar, and freightage from there is much less than from America or Australia. They now fear that this slang phase may give the meat a bad name—or odor, and that Paris may refuse to eat it.

Reactions of Turtles to Color.—Marine turtles lay their eggs on dry land, and as soon as the youngsters are hatched they make straight for the sea Carnegie Institute men in the Dry Tortugas sought to find the influence that guided them to the water When a sheet of red or yellow paper was placed between the baby turtle and the sea, it would turn and go in another direction; but a blue sheet drew him toward it no matter where it was placed It would seem, then, to be color, rather than instinct or smell, that attracts the youngsters to the water

Pests, or Benefactors?—What is evil under one set of circumstances may be good in another, as the latest report of the Biological Survey strikingly illustrates. Coyotes, we learn, are the most effective in keeping the plague of rabbits within limits, but the coyote in another aspect is so evil that we have put a price on his head The meadow lark is a pest, in that it destroys sprouting oats,—a benefactor, in that it is a ravenous eater of grasshoppers. The benefit of turning pond-holes into cranberry swamps results in the evil of low ponds and less fishes. Wherever civilization turns it is confronted by that inexorable dictum: "For every gain, a loss, for every loss, a gain." Sane compromise is our only salvation.

The Hudson River Caissons

Giant Shafts from Which the Vehicular Tunnel Will Be Built and Later Ventilated

By Robert G. Skerrett

The Canal Street caisson during the riveting-up period preparatory to the sinking process

THE Hudson River Vehicular Tunnel has been advanced a structural step by the recent completion of the sinking of two great caissons at the Manhattan terminals of the undertaking in the neighborhood of Spring and of Washington Streets These caissons are next to serve as points of departure for the driving of the twin subaqueous tubes, and, finally they will form permanent ventilating shafts.

Because of their magnitude and the proximity of business buildings, the execution of this work has demanded a goodly measure of skill, and, as might be expected, the aim has been to get the caissons down into position well below the ground-water line without endangering the adjacent structures Further, the desire has been to minimize as far as practicable recourse to rather expensive underpinning in order to secure these buildings against settlement. These results have been realized by a somewhat novel departure in the sinking method adopted

For the sake of those persons that may be interested in dimensional data let it be said that the caissons measure, each, in cross section 47 feet by 42 feet 4 inches—the Spring Street caisson has a span from top to bottom of 58 feet 7 inches and the Canal Street one has a total height of 60 feet. The depth of submergence below the level of the pavement is 8 feet in each case—this brings the tops of the caissons to a point a short distance above mean high water It should be apparent that the sinking of these gigantic boxes of steel has necessitated the excavation of much earth in order to get their cutting edges down to their present resting places in a stratum of sand In connection with the Canal Street caisson it was needful to break a way through the interposed cribbing of an old dock. This is suggestive of how the Hudson River waterfront of Manhattan has changed in the course of time, for the modern bulkhead line of the city piers lies quite 250 feet further riverward to the west.

Taking them all in all, these caissons are bulkier structures than those of a kindred character previously sunk for railway tubes under either the East or the Hudson Rivers, and yet they have been got into place with marked celerity For instance, the rate of sinking at Spring Street has been 2.69 feet a day while at Canal Street progress downward was 4.84 feet a day At Clark Street, Brooklyn, where the material to be penetrated was the same as at the sites of the two vehicular tunnel shafts, subsidence averaged 2.94 feet daily and 68 cubic yards of earth had to be removed with each foot of settlement. On the other hand substantially 74 cubic yards had to be got out of the way to effect a similar descent in either of the more recent undertakings.

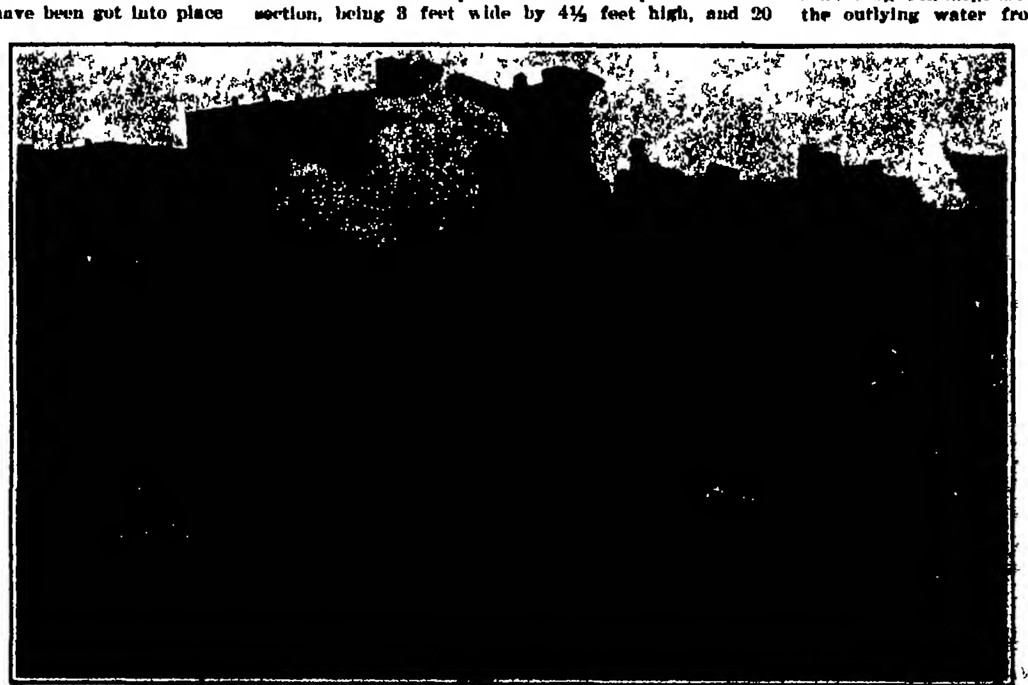
The procedure adopted was identical for both of the vehicular tunnel caissons. To be specific, a pit was first dug 10 feet deep and dimensioned to correspond to the cross section of the caisson, and in this excavation which reached down to ground water, the steel frame of the caisson was erected and the plating riveted into place When completed, compressed air was applied from an associate air plant installed for the purpose, and the actual process of sinking was started This consisted in removing the earth lying within the area bounded by the four cutting edges of the rectangular structure and then in hoisting the spoils surfaceward through two tubes equipped at their upper ends with suitable air locks The lower chamber of the caisson was, in effect, a diving bell and the function of the compressed air was to hold the outlying water at bay so that the sand hogs could clear away the exposed muck, rock, etc

As is pretty well known, ordinary caisson sinking in forming foundations for skyscrapers, bridge piers, etc entails rather rigorous treatment of the men when passing up or down through the muck lock, for precious little time is given them for readjustment to the changing air pressures. Further, because of their limited size, the muck locks can accommodate only a few operatives at a time—a feature likely to involve peril in case of an accident calling for the speedy exit of a whole crew To minimize this hazard and otherwise to provide better for the physical wellbeing of all concerned, the vehicular tunnel caissons were fitted with what is termed a T-head lock which was set between the two muck locks of each structure and linked with the working chamber by an independent hoist or tube This special lock was elliptical in cross section, being 8 feet wide by 4½ feet high, and 20 feet long. A bench extended along each side, and there was room enough within for the simultaneous occupancy of a whole shift or working gang of fifteen men This made it possible for the outbound or the ingoing crew to undergo deliberate decompression or compression, as circumstances required, and thus obviated subjecting them to sudden alterations of pressure which frequently induce more or less serious physiological disturbances. The T head locks as well as the muck locks were so placed that they were always above the water line, and this served as a safeguard in case the air supply failed or it was no longer feasible to maintain a sufficient pressure.

In sinking the caissons the maximum air pressures employed were 22½ pounds for the Spring Street caisson and 27½ pounds in getting the Canal Street structure down to its deeper resting place Operative air was furnished by a battery of compressors capable of providing 2800 cubic feet of air per minute In other words, this was the buoyant impulse which sustained the gradually descending caissons and, incidentally, kept out the outlying water And now we come to the most ticklish phase of the entire job.

As may be readily grasped, the settling caissons resembled in principle the downward motion of gigantic pump pistons owing to the close fit of the contiguous walls of earth and to the fact that water enveloped them on four sides. One of these caissons was sunk only 20 feet away from the foundations of neighboring buildings and reached to depths considerably below the lower limits of these adjacent substructures It was imperative that counterbalancing air pressures should be brought into play so cautiously and skilfully that the movement of the caissons would not provoke reactions of the ground water that would be likely to wash out or cause the displacement of the soil sustaining the weight of the near-by business edifices.

Each pound of air pressure applied within the working chamber of either caisson produced a buoyant or up lifting movement of about 144 tons, carrying the caisson's weight in large measure and incidentally prevented the outlying water from rushing into the chamber Conversely, had the air pressure dropped suddenly there would have been a corresponding invasion of the surrounding water and a coincident undermining of the walls of the pit. Such an erosive action would have menaced the property flanking the excavations. The problem was intensified with each foot of sinking, because the added air pressures required exerted a greater force upward Had this reached a point where it actually could have raised the caisson, the consequent suction or inward flow of the water would have been akin to that provoked by an abrupt drop in pressure within the working chamber. To combat this peril the expedient was adopted of loading the upper section of each caisson with a compensating amount of muck, and this gradual augmenting of the caisson's deadweight effectually neutralized the uplifting impulse of the increasing air pressure.



The Spring Street caisson, from above, at an early stage during its sinking

Uncle Sam's Big Camera

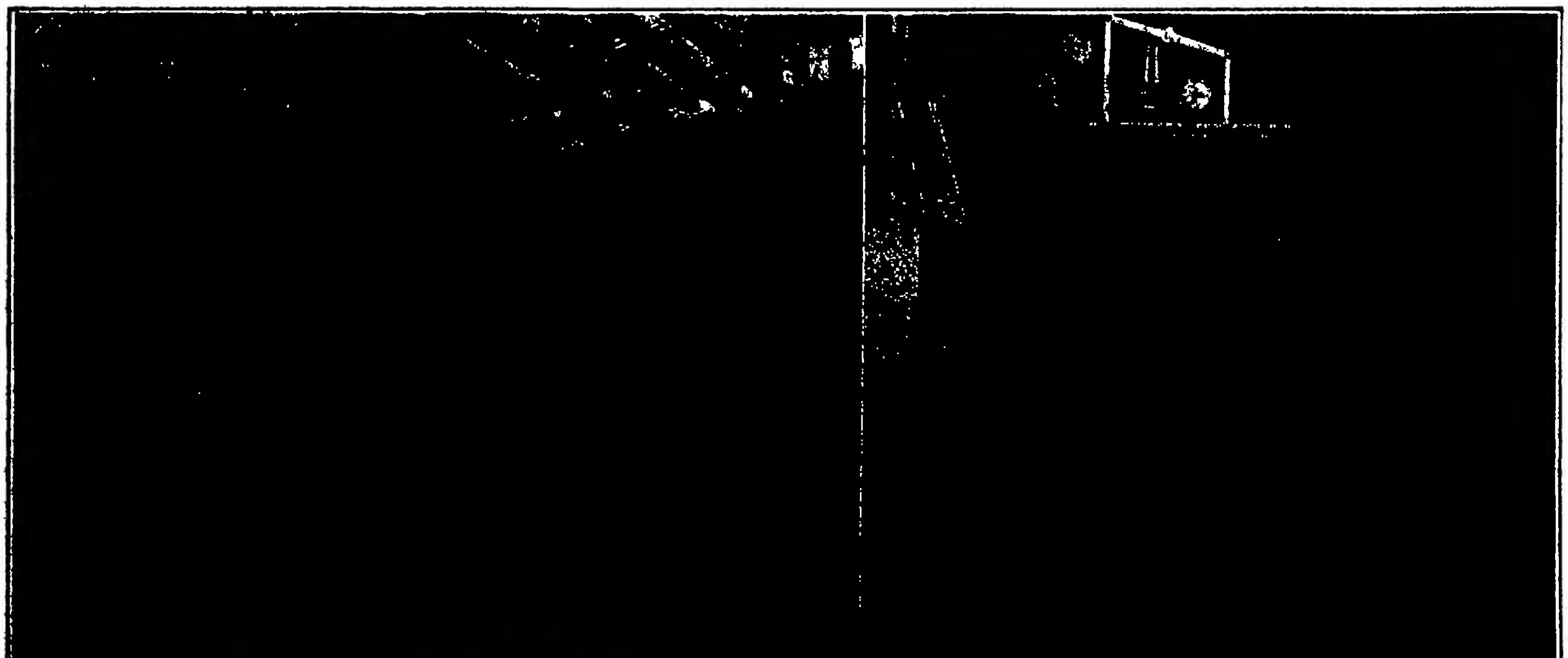
IN the monster camera just installed in the United States Geological Survey professionals and amateurs alike are sure to be interested. Great as has been the ingenuity displayed during the intervening years since Thomas Wedgwood first discovered that pictures could be produced by the action of light on a sensitive surface, none seems to have so completely filled the need in copying processes as this novel prismatic camera Designed by A. H. Linsenmeyer, the Survey's leading photographer, the three-and a half ton giant, hanging from the ceiling, dispenses with the perplexing problems of alinement, focusing, etc, and responds to direction by electricity or by hand more readily than does the tiny kodak to the grasp of a steady pair of fists. Nowhere are higher standards of accuracy maintained than in the Federal Survey, and that absolute scale is secured in the reproduction of every map is due largely to the fact that the big machine is exact in every movement to the smallest fraction of an inch

Save for the bellows and curtain-slide, which are of rubber, the camera is an all-metal affair Flexure and distortion of image—faults which are common to the ordinary make—are unknown to this marvel of the picture world A rigid tubular steel frame, ten by sixteen feet, is suspended from the ceiling by springs so attached as to offset any possible vibration of the build ing From this massive frame hang the several parts of the camera, in the operation of which the usual method of copying is reversed In one corner is the plate-holder, projecting a ways into the darkroom In front of this is the bellows, terminating in lens and prism, attached to a carriage which moves on two parallel rod-rails. Resting on this carriage and traveling at right angles is a second carriage supporting the copy-holder. And here is where the process differs from the ordinary practice, the lens and copy-holder move toward or away from each other, according to the size and scale of map desired, but the plate-holder remains stationary inside the darkroom. This dispenses with the constant squaring up of camera and copy-holder and practically eliminates the time-consuming operation of focusing. The lens is moved forward or backward by the motion of the first carriage, which opens and closes the bellows in accordion like fashion The uniformity of bellows movement is regulated by lazy tongs on either side which give the camera front the appearance of a huge jack in the-box.

As previously pointed out, the plate-holder of the marvelous machine is firmly attached to the main frame and extends into the darkroom It has an automatic plate-centering device, aluminum drip-trough, half-tone screen holder, screen-distance-regulator, spring support for holding the plate in position, and a rubber curtain which keeps out the light during exposure Just beneath the plate-holder are four hand wheels which make one think of a pilot house Two of the four function the lens giving it horizontal or vertical motion as you will The others move the bellows and regulate the matter of copy distance All four wheels are connected by chain gear to square revolving rods, along which slide bevel gears, an assembly which permits motion to be communicated to the gears at any point in their travel And if the photographer chooses to operate the machine from the darkroom, he can peep through a little red window and watch the copy-holder and lens swing into position for the picture

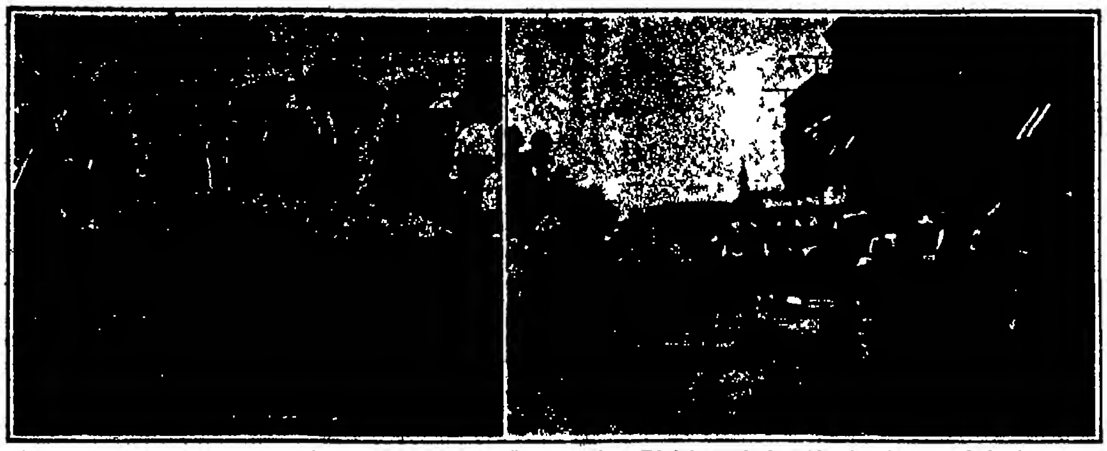
This is a steel frame carrying two heavy glass plates four by six feet The copy is placed between them, but perhaps you are wondering how, for the illustration seems to have them permanently fixed This is true as regards the front plate, which is ever in correct alignment with the lens and plate-holder The rear glass, however, drops back from the top, bookwise, when you turn a hand wheel at the side of the frame This releases eight felt-covered cams (four on each side of the frame) and when the copy is inserted, either from the top or from the side, the wheel is again turned and the rear plate is jammed against the front If perchance the copy should fall between the glasses at the bottom, the operator can "fish" it out with spe-

(*Continued on page 263*)



Left: Operating the new prismatic-process copying-camera from the electric switchboard. *Right:* Plate-holder, seen from behind the instrument, inside the dark room

Radio-Controlled Automobile



The radio-controlled car recently developed by the Engineering Division of the Air Service at McCook Field, Dayton, Ohio, standing still and under way

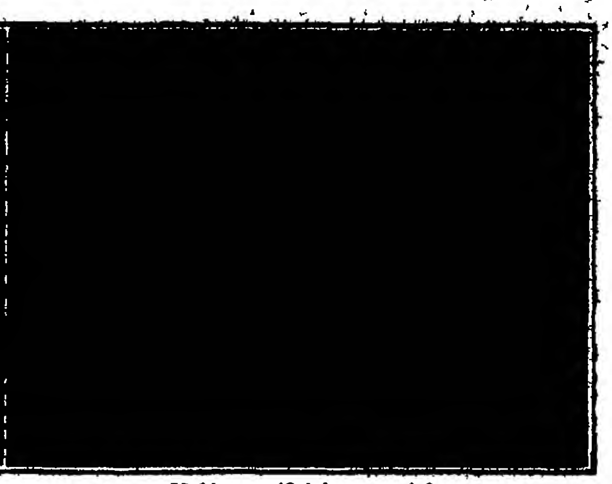
RECENT visitors at McCook Field, the home of the Engineering Division of the Air Service at Dayton, Ohio, have been astonished at the gyrations of a brightly painted three-wheeled vehicle which has been dashing to and fro between the build ings and among the airplanes on the field under no visible means of control It is often seen to approach a group of persons blowing its horn wildly, and then when apparently about to strike them, to stop short with screeching brakes, back up with loudly clanging blow, make a sharp turn to the right or left, and to start off in the opposite direction Great mystification has been shown as to the method of operation of this car, some visitors even wondering if perhaps a combination of weather and newly made home brew may not have had a deleterious effect upon their observational powers. They are ofttimes considerably relieved to learn that the car is actually performing as they have seen it, though the mystery is lessened but slightly when they learn that the movements of the car are controlled entirely by wireless signals, which are sent out from the radio station at the opposite end of the flying field The fact that there is no aerial or antenna system visible merely adds to the mystification

The car is of cigar shaped construction, about 8 feet long and runs on three pneumatic tired wheels. It travels at speeds ranging from 4 miles per hour to 10 miles per hour and the controls are so finely adjusted that it may be easily steered along a narrow road way

An examination of the interior of the car shows an amusing and confusing collection of batteries, switches, wires, vacuum tubes, potentiometers, relays, magnetos, etc., all of which are, of course, necessary to the complete control of the apparatus. The most interesting part of the apparatus is the "selector" which is in reality the heart of the entire control system. Various combinations of dots and dashes are sent out by means of a specially constructed transmitter, each combination calling for the accomplishment of a certain operation of the control apparatus It is the function of this selector to "Decode" these various combinations of dots and dashes which are sent out, and to close the circuits to the desired controls The selector makes it possible to put into operation any one of 12 distant controls in less than one second

Coloring a model of an invertebrate with an air brush

Mr. Dwight Franklin Modeling a lizard



Making artificial seaweed from celluloid

Behind the Exhibits

Departments and Activities of a Museum Which the Layman Never Sees

By Albert A Hopkins

AS we roam through the halls of a great museum we are prone to think that the exhibits require little preparation before they are shown to the public The very reverse is the fact, and a few astounding statements can be made which may not be true for all museums, yet are correct for the greatest of them all, the American Museum of Natural History In the first place, about four-fifths of the material is in storage, not necessarily boxed up and piled in storerooms, but arranged in fireproof, dustless rooms, cases, presses, and other containers. The rooms seem endless, yet if a student really wants to see bird skins aboriginal skulls, prehistoric stone implements, etc., he will find a collection so extensive that the volume is almost appalling

For example, the ethnological collection embraces 100,000 catalogued specimens. There are 2000 human crania, 500,000 insects, 150,000 bird skins, 100,000 invertebrates from one expedition, and so on It might well be asked why only twenty per cent of the objects acquired are shown The answer is simple, for in the case of Natural History the vast majority of the speci mens are in the study series, not only because they would ultimately be ruined by exposure to light, but because the display of all material would only confuse the visitor Moreover, no museum has room to show everything, and a careful selection is made of objects of the greatest educational value. These are so displayed as to enhance their interest and attractiveness. The aims of a museum of natural history are multifold and might be defined as follows

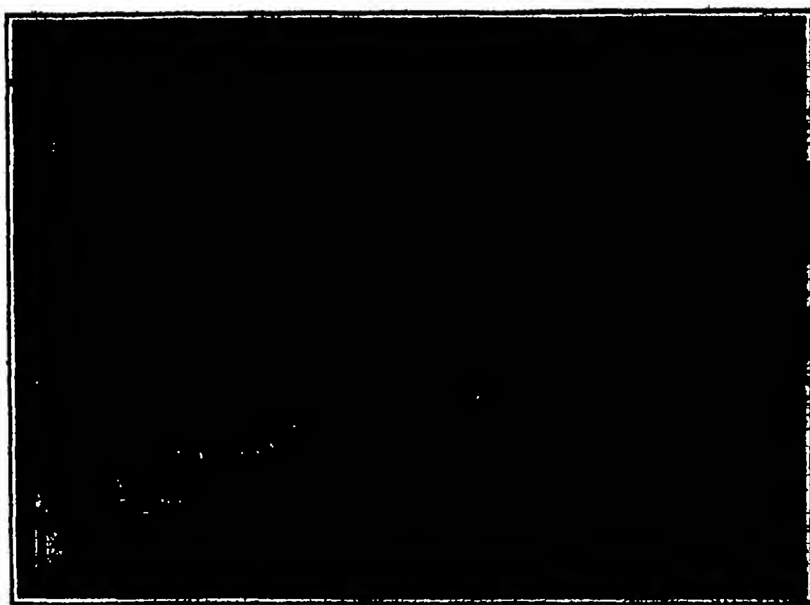
The purposes of a great national museum of natural history are (1) To procure by its own explorers or by the voluntary assistance of independent naturalists the actual specimens upon which accurate knowledge of the animals, plants, and minerals of the earth's surface, and more especially of the national territory, is based, to preserve and arrange these collections for study by all expert naturalists, and to facilitate, directly or indirectly, the publication (in the form of catalogues or monographs) of the knowledge so obtained, with a view to its utilization, not only in the progress of science, but in the service of the State (2) To exhibit in the best possible way for the edification of the public, at whose charges these collections are made and maintained, such specimens as are fitted for exposure in public galleries, with a view to the intelligent and willing participation of the people in the maintenance of the museum As the museum is emphatically "for the people," special attention is given to making the exhibits attractive and interesting, as well as instructive

While the American Museum of Natural History cannot claim to have originated the idea of displaying animals amid their natural surroundings, it was the first large museum in the country to adopt this method which it has since carried out on a large scale in the well known "habitat" groups. In the museum were also developed the methods of preparing and mounting the skeletons of extinct animals that have resulted in such mounts as *Brontosaurus* and *Tyrannosaurus*, and the series showing the development of the horse, so that they might be something more than an assemblage of uninteresting bones

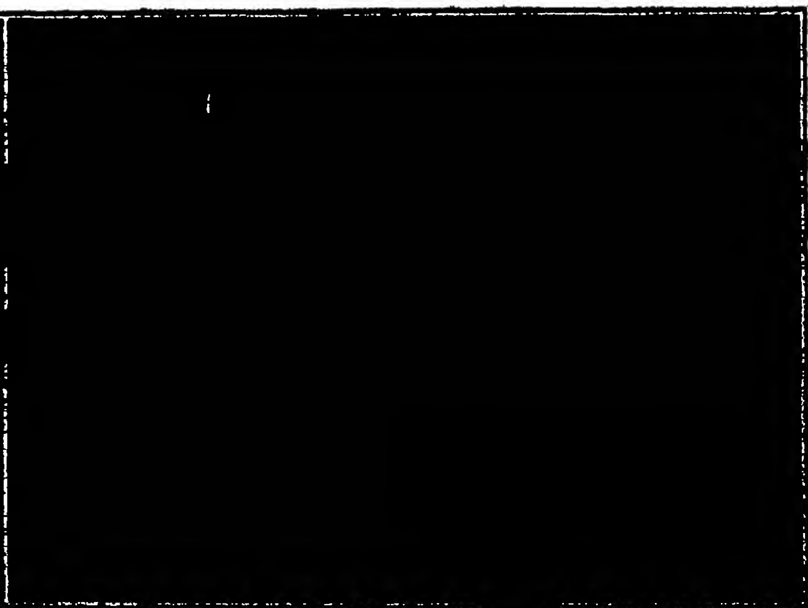
It is with the greatest liberality that this museum gives the results of special methods of preparation to the scientific world, and while the great public, to the use of which the great structure is so largely dedicated, cannot, of course, be admitted to the laboratories and preparation rooms, yet our readers will be enabled to visit pictorially, at least, these veritable hives of scientific industry. With the permission of the Director, Dr Lucas, and under the guidance of Mr. Miner, Associate Curator of lower invertebrates, the writer spent a most fascinating day in the huge building, which is, by the bye, 710 feet long

In the basement is located some of the shops which require considerable space, as the carpenter shop, where cases of all kinds are made as well as the wonderful queer-shaped pieces of wood for the "insides" of animals, called "armatures." The Museum staff have designed cases and moth-proof containers of all kinds which show great inventive skill. In the Museum of the old school, and there are many of these, the objects were exhibited in a cold, formal way, out of contact with the real environment, and the skin was painfully stitched to gunny sacking covering the skeleton. The skin was distended by the judicious use of sawdust. Now all is different. A field staff goes to Africa. They are extremely versatile, some study the jungle, some study the rocks; others photograph or make color studies, while still others spend their time in investigating the habits of the huge animal who is unknowingly facing the bullet from the elephant-gun of the naturalist-hunter

The skin and bones are preserved and are shipped home. A year or so later the staff members reassemble and begin to visualize what they have seen in far-away Africa They build an artificial jungle of wire, wax, celluloid, glass, and the thousand and one articles which these up-to-date "preparators" consume, for the old-time taxidermist is in the discard The artist paints the background; the sculptor models in clay the great



Making the framework for a whale



Trying on a skin over a [illegible] body

Working on the Nahant tide pool group, one of the finest marine groups ever attempted

work of the figure; plaster casts are made, using an artificial framework of wood and iron to take the place of the bones which are being boiled clean in an adjoining laboratory before they are articulated. Then comes the "putting-on" process in which the hide is fitted to the new body, and, finally comes the glass blower who takes proper notes for the eyes. In due course the public is admitted to see the completed product. Labeling comes later, for a museum's labels cannot be made hurriedly. The time and care lavished on labels are almost beyond belief; a set of labels often takes two years in the preparation. With birds or butterflies the method of procedure is the same, and the wonderful bird groups have been the delight of thousands. The same general plan is adopted throughout the other fields of endeavor, such as ethnology, anthropology, geology, palaeontology, and mineralogy

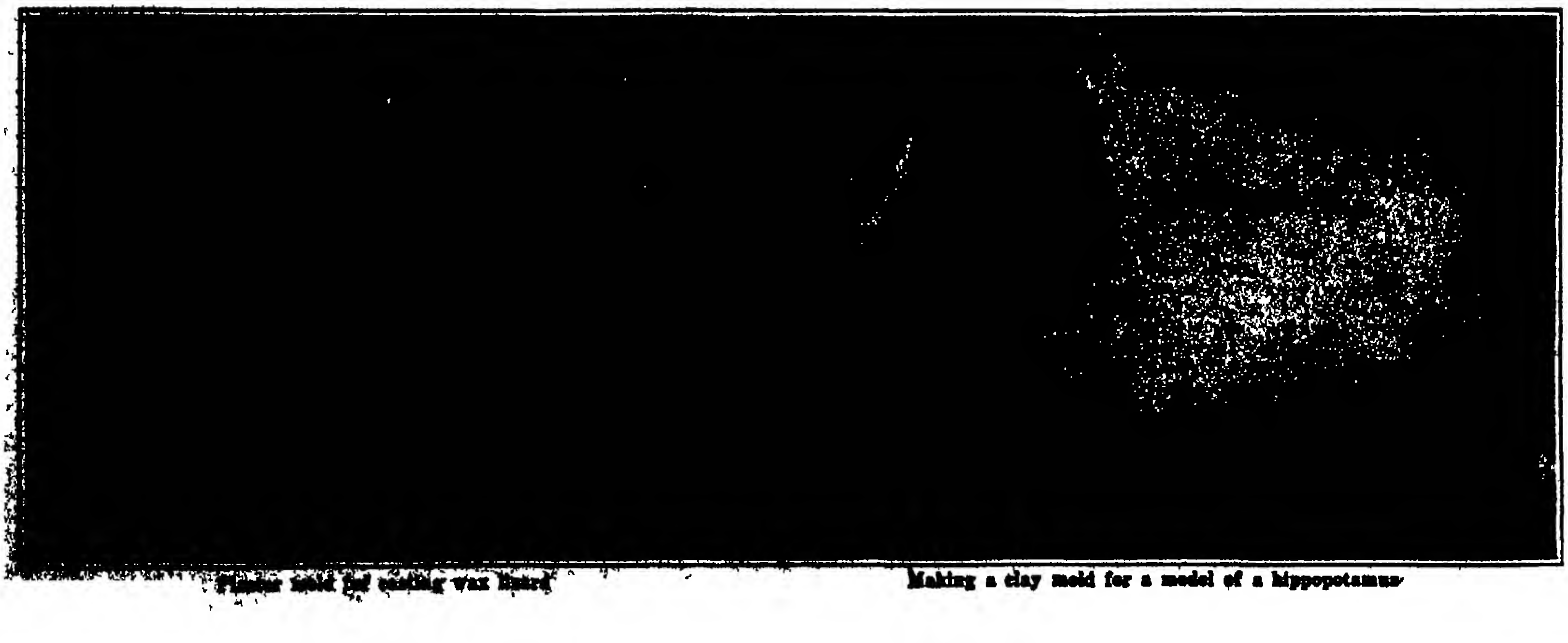
In the palaeontological portion of the geological field the specimens begin to be prepared in the locality where the find occurs. The fossils are covered with plaster of paris and gunny sacking, together with a sufficient quantity of the gang-rock to insure the great or less integrity of the remains. On arriving at New York, the bones are carefully removed from the matrix and a huge flexible drill, like a gigantic dental engine, serves to fit the various bones together The gaps are finally filled in and the huge articulated extinct animal stands out in three dimensions, or flat against a slab Progress photographs are constantly being taken so that an imperishable record is made of the way it was all done.

Wax flowers enter into nearly all of the groups, and it was found necessary to invent a whole new process, which will form the subject of a subsequent article Sometimes tin flowers are required, and the museum has to have a tinsmith who can make anything The glass blower is an important artisan, we might almost say artist, his services are constantly required, especially for making models of insects, invertebrates, etc, and he is all-essential when marine groups are being made

This brings us to, perhaps, the most interesting phase of this fascinating subject—the invertebrate groups, which are gradually spreading from window to window in Darwin Hall. This series portrays the invertebrates in their natural surroundings, and serve to emphasize certain biological principles which cannot be enlarged upon here further than to say that these groups illustrate within themselves all those laws which lie at the basis of the doctrine of evolution, to the presentation of which Darwin Hall is dedicated The making of these groups requires years of time Hundreds of studies may be made in the field, from the objects themselves often drawn from observation under water, or under the microscope These studies are by various hands and are allowed to accumulate for four or five years when the actual work of preparation is begun. The general physical presentation is discussed and small models like those designed by stage directors are made After all ideas have been carefully threshed out, each one begins the fabrication of his part. One man takes crabs, for instance, removes the body from the shell, models a new body, puts it back in the shell, articulates legs and claws and paints—for all time—the colors which were all too-evanescent in its brief life on the sandy bottom Then there is a whelk, a hermit crab, and a snail, all are treated in the same way There is eel grass to be cut out of sheet celluloid colored by hand and with the airbrush Meantime the artist has been painting the background on successive sheets of glass which are constantly being tested for the effect. The making of seaweed is a large order, but with punches of a half dozen different designs this part of the work goes quickly enough The specimens are studied in situ and photographs and drawings brought down from Wood's Hole, or elsewhere, and the next operation is to fix them permanently in wax or glass, for organic matter will decompose quickly, or if preserved in alcohol becomes so deformed and bleached that it is a travesty of the living animal The animal life, with the exception of hard structures, such as shells, is an assemblage of models.

The mussels on the piles are the actual specimens which were preserved in alcohol and afterward taken apart, the soft portions cleaned out and the shells reassembled with wax and cotton The worm tubes are the natural dried specimens recolored The starfish was also dried and prepared with a wax foundation, the tube feet being modeled in glass and inserted. The tubularian hydroids were all separately blown in glass and welded together in colonies, the sketches made in the field and the original alcoholic specimens being used as patterns The color was sprayed on with the air brush, the finishing touches being made by hand in the usual manner with paints. Hundreds of tentacles for the sea anemones, cirri for the *serpulid Hydroides dianthus*, and even some of the seaweed are also the work of the glass blower, but perhaps the best work in this line is the modeling of the jellyfish and the squid The former is entirely of glass and is a masterpiece of the glassblower's art, while the peculiar translucency of the squid's body could be obtained by no other medium The coloring of these two models by the Japanese artist is also a triumph of skill Much of the animal life, however, was modeled in such materials as wax and celluloid A single exhibit may consist of 200,000 to 300,000 objects fashioned by the hand of man so that it is little wonder that three or four years is a little period when a group like this is considered The expense which runs up into thousands is fully justified on account of the permanency of the exhibit which, with proper care, will be in existence long after our grandchildren have passed away The bryozoa group is most popular, for we apparently look through a huge magnifying glass three feet in diameter, at a bit of the bottom of the sea where the seaweed is three feet high Alice in Wonderland never saw such a queer assemblage of wax, glass and other objects, for everything is laid under contribution, and the effect is the same as if actually viewed with a magnifying glass of normal size Another magnifying glass will show us pond life in a year or so as it is now in process of construction We have dwelt particularly on the invertebrate groups, because of the invention which has been displayed by all these habitat' groups, but particularly those dealing with the lower form of animal life, for though a bird or animal group may require painstaking labor and the skill of the sculptor they do not require as much invention and resourcefulness as do the lower invertebrate groups

It might well be asked if the time and money which are expended are justified It is, indeed, a wise expenditure of money for the creation of educational exhibits which will prove a delight to the people for a century or more to come



Plaster mold for casting wax lizard

Making a clay mold for a model of a hippopotamus

The Science of Athletics

What Is It That Distinguishes the Star from the Mediocre Performer?

By Charles W. Paddock, Olympic Champion, 100 Meters

EVERYBODY must, at one time or another, have been puzzled to know just what it is that determines athletic ability Jim Barnes, Ted Ray and Jock Hutchinson, for instance, three of the world's best golfers and three of the longest hitters, are of three diametrically opposed types Barnes, extremely tall and willowy, Ray, built in every proportion like a truckhorse, and Hutchinson, just the reverse—short, slight, wiry Every game offers similar contrasts—even a sprinter is sometimes found of gigantic or near-gigantic proportions, while a long distance champion may be small and apparently frail Just what is it that these types possess in common that makes them champions? It is this question that Charlie Paddock, Olympic quarter-mile champion, has asked and to his own satisfaction at least answered in this article It is merely, he insists, a case of subjecting the muscles, by intelligent training, to the complete domination of the will.—THE EDITOR.

THERE are two characteristics which go to make an athlete, muscular development and nervous energy It makes no difference how many other qualifications a man may have, if he does not possess both of these in at least some small degree, he will not make a success in any kind of competitive sport.

A man who already possesses natural physical strength has a distinct advantage over the man who is forced to develop it through a course of rigorous training Because the man who is a born athlete, if he spends an equal amount of time in training himself, will become a super-athlete, and a champion However, it is not impossible for a man to become a great athlete, even though he be handicapped by a poor physique in the beginning Indeed some of our greatest performers today are men who do not have the appearance of athletes, and yet possess an uncanny degree of strength in certain fields of physical endeavor Richmond W Landon of Yale University, Olympic Champion in the high jump does not have the appearance of an athlete, yet he has so developed himself as to have a greater amount of spring in his legs, than any other jumper in the world Morning, noon and night he skipped rope, jumped for imaginary apples, hung high on imaginary branches, until it became with him a habit to jump Then when he first attempted leaping the high jump bar he wore heavy shoes and clothing, and when at last he was able to clear high heights in such garb, he donned a track suit and spikes, which gave him the lightsome feeling that so impresses the spectator who watches this slim, unathletic looking person clear heights which natural born athletes dare not attempt But in golf and tennis, and more particularly in running nervous energy is more important than muscular development. Its a question of nerves more than strength to sink a ten foot put, when it means the match, or to avoid serving doubles in the game that means the set, or to get off with the field, in a short distance race where the start counts for everything

There was a great sprinter in this country, recently retired, who was the fastest man from the mark among the great indoor track competitors. His perception of the starting pistol report was so lightning-fast that his muscles seemed to react to the sound of the gun, without any mental command on his own part On the ordinary man who should start beside him he would probably have gained ten yards in the first twenty, while against the average track man he would easily gain two yards in that distance, and even the greatest opponents conceded two feet to his start because of that marvelous reaction of his But this little fellow, Jackson V Sholtz of the University of Missouri, had worked long and hard to gain this advantage. And it was not only the result of physical effort and practice, but was also due to the training to which he had subjected his nerves

And herein lies the hope for the man of business of keen brain and unresponsive muscles. He can train himself even as Sholtz and Landon have done, to such a physical state that his muscles will react to his will, and though he may never have the strength of a Ralph Rose or the speed of a Jack Sholtz or the spring of a Dick Landon, yet he will have enough of that muscular development to pair with his nervous energy which he has gained, to become a champion athlete

It has been said that a man cannot begin late in life to play any game and become a champion But there is not very much to that theory It has been upset too many times. It might apply to the gray-haired veteran who attempted to run a race or play football, but even then there have been so many exceptions the rule can hardly stand Some of our greatest athletes never began until late in life, and not all our baseball players were born with the rawhide sphere in their hands. As for golf any man if he is physically fit, or can make himself so, can by practice become a 90 per cent man, and with sufficient handicap can win tournaments.

This training to become a champion does not take all of your time Indeed, it consumes just enough to give a man the essential recreation which he needs for the pursuit of health It can be engaged in so as to benefit business as well as physique, and when the practice days are past, you will have the satisfaction of feeling that you can conquer in competitive sport, which is one of the most satisfying of feelings.

The old theory used to be that in order to attain success in athletics a man could do nothing else but prepare himself for his own particular event to the exclusion of any other work That idea does hold good, in that a man can really be a champion in only one athletic endeavor at a time. This is the age of specialization, no doubt of it, and if a man will take up one event and religiously perfect himself in it, he will certainly succeed. Of course there are a select few who can do a number of athletic feats well, and a few who have become stars in two or three different fields. Many college men become proficient in both football and track, but there are very few who become champions in more than one kind of competitive sport. The victory of Miss Mary Browne of California in the southern California Golf Championships coupled with her brilliant career in the world of tennis makes of her one of the most notable exceptions to the rule

But outside of specialization the theory that a man can do nothing else but athletics, if he is an athlete, is incorrect Indeed, athletics is similar to business in that the star performers in each field must have relaxation in the other in order to be at their best

For several years the writer has been engaged in newspaper work and college studies and at the same time has been doing track work The two have gone hand in hand, and each has been benefited by the other Because of that need for relaxation, athletics was first taken up In order to create a definite interest in daily exercise, one particular event was chosen, and it was made a specialty with the result that the real business of life was improved, and at the same time a new pleasure was created by watching the improvement of my work on the track.

The only difference between my training and that of any other athlete is the fact that within a week's notice, providing of course I have not been the victim of some illness, I could make myself ready to enter my hardest competition with every confidence of being at my best. That is the greatest pleasure of athletics, having the feeling that I am physically fit. So often athletes have found themselves in the worst possible physical condition within a few days after strenuous competition, because they have suffered reaction from training and gone to the other extreme of dissipation. But if a man pursue a moderate course and keeps himself in good condition at all times he will not have to train so strenuously just before a great contest, and therefore will not feel the need of breaking training immediately the ordeal is over.

In order that a man may not become weary of the particular sport wherein he is most adept, it is a good idea to engage in some other exercise part of the time, and only train in that certain field of athletics a few weeks before competition. For the first thing essential to success will be condition, physical condition. It makes no difference what manner of exercise you have taken so long as you are fit for the contest.

After gaining your condition, and by that I mean feeling strong and well, having strength and pep, and being able to engage in hard work in the daytime and sleeping well at night, the amount of practice which should be engaged in prior to a contest of course depends upon the amount of playing that has been done by the individual For example if it were track, and the man had run several seasons, in high school and college competition, a couple of weeks' running and a week devoted to starting practice would be about all that was necessary, providing always the contestant was already in good physical condition.

If the athlete had never competed in that form of athletics before, or indeed had never taken an active part in any kind of competition, there are several methods of enjoyable exercise which should prove strengthening, particularly if the form of sport contemplated was of a strenuous nature. There is nothing which will develop a boy or young man so quickly or so well as swimming. Bicycle riding, too, if not engaged in too strenuously is wonderful exercise, and walking, along with either of these, furnishes a combination of muscular development hard to surpass. But if swimming is the form of sport the neophyte desired to perfect himself in, then a great deal of running would prove profitable. In the first place it is the direct opposite of swimming and develops an entirely different set of muscles. So that when the runner becomes a swimmer he can tell the progress he is making by the degree of soreness which he experiences. This soreness of course indicates that other muscles are being developed, and unless you swim a very great deal which is not good at first, then it will take you a much longer time to develop your muscles. Again, in swimming, it's your chest and shoulders and arm muscles which receive the most attention, and by running you have also developed leg muscles as well When you become a champion, that extra development which the running gave you, will give you an advantage over the great swimmer, who never ran And so the theory holds true in many kinds of competitive sport. Though you may specialize in only one, you may gain a great deal of assistance from the participation in other kinds of athletics.

Joie W Ray, considered by many the greatest mile runner who ever lived, wins his races simply because he had development in another kind of sport before he became a long distance runner Ray boxed a great deal when a boy, and developed a marvelous chest and lung capacity He also had a splendid pair of legs.

The mile-race, as you know, is usually run on a quarter-mile track, and after the runners have circled the oval twice, Ray starts his sprint All other milers wait until the fourth lap to begin running their hardest. So when they meet Ray, and he runs away from them in the third lap, they don't know what course to pursue If they attempt to stay with him they may hold him for that lap, but when the fourth and last quarter is reached they have run their race, while the great reserve that Ray has gained from boxing enables him to fight it through to the end. On the other hand if the milers pursue their usual tactics, and wait until the fourth lap to sprint, though they may gain on him, Ray is so far ahead that they never can catch him.

Though boxing may help you in running, and running in swimming, and swimming in tennis, etc., the essential stuff of which champions are molded is confidence It is produced by nervous energy and the belief that you surely can do the thing you set out to accomplish.

The right mental attitude is after all the most important part about athletics. Belief in yourself and in your own ability is certainly one of the foremost stepping stones to athletic success. If you have nervous energy and plenty of it, and a firm belief in yourself, you can develop the necessary muscles through practice in different forms of exercise to become a star in almost any branch of competitive sport for which you are fitted.

And it is not a question of eternal playing either. If within a few months you show no signs of improvement, then change to another kind of athletic activity, there are plenty of them, and keep changing until you do find yourself. Then stick to it, and if you get out only once a week, at least practice a little bit at home in the morning before business, or in the evening when the day's work is done.

High Pressure Steam

A New Departure in Power and Heating Plant Engineering

By Our Berlin Correspondent

IT had long been thought that the maximum efficiency possible at the present stage of steam power engineering could not to any material degree be improved upon. The best steam consumption figures ever recorded in engineering literature are probably those obtained by Heilmann with a Wolff locomobile (semi-stationary engine) 15.5 atmospheres, or about 230 pounds initial pressure and 465 degrees Centigrade, live-steam temperature, there were used only 3.3 kilograms of steam per indicated horsepower-hour, corresponding to a heat consumption of 2670 heat units.

That far better results can be obtained by the adoption of extremely high steam pressures has, however, been strikingly shown by Hartmann, who gave, at the recent Congress of German Engineers, an interesting account of the results achieved in this connection by Dr Wilhelm Schmidt and his assistants.

When the adoption of steam pressures far exceeding those so far in use was first suggested, the attitude of engineers and scientists alike was skeptical The results obtained in the course of ten years' operation of one high-pressure steam-boiler plant, as well as tests made on a number of high-pressure reciprocating engines, have shown this skepticism to be unfounded In fact, it may now be affirmed that there is absolutely no objection to designing huge steam power plants for initial steam pressure up to 60 atmospheres (about 900 pounds to the square inch)

There are mainly two fields where "high pressure" steam, that is to say, steam of more than 30 atmospheres initial pressure, has so far been shown to be used with advantage, first, in power plants operated with condensing engines, and second, the more and more urgent linking up of power and heating plant engineering. Unexpectedly favorable results were obtained in both these fields. In one case, a condensing high-pressure reciprocating engine of about 145 indicated horsepower with 55 atmospheres initial pressure, 335 degrees Centigrade live steam temperature, a 95 per cent. vacuum and double intermediate super heating, was found to exhibit a working steam consumption of only 2.33 kilogram (5.13 pounds) per horsepower-hour and a heat consumption (inclusive of intermediate superheating) of 2,070 heat units, as reduced to a feed water temperature of zero Centigrade In the case of larger units, however, even better results may be anticipated

When comparing these results with those referred to in the beginning, a saving of heat as high as 22 per cent will be found to have been secured, while the opinion, still prevailing, that intermediate super heating insures no useful results, has been shown to be erroneous. In fact, a coal consumption of 300 kilogram per effective horsepower-hour can now be relied upon in the case of large units, with 80 per cent boiler efficiency, using coal of 7,500 heat units per kilogram. In designing large high-pressure steam power plants, the upper part of the gradient should preferably be made use of in high-pressure reciprocating engines, the lower in low pressure turbines. High-pressure condensing engines will mainly be used as driving engines for vessels.

The advantages of high pressure steam in stationary plants are especially conspicuous in the linking up of power and heating plants The lecturer, in the case of initial pressures exceeding 30 atmospheres (450 pounds), has observed a remarkable interaction between initial and back pressures In fact, the specific steam consumption of unit capacity, with live steam tensions of 30 atmospheres and more, and back pressure rising to 10 atmospheres and more, was found only to increase as the back pressure It will thus be possible without any material loss of energy to use higher back pressures than those hitherto employed, thus enabling operations such as vaporizing and heating, heretofore dependent on the use of live steam or the direct application of fire gases, to be carried out with exhaust steam Moreover, any difficulties connected with the distance separating the steam generator from the place consuming the exhaust steam, will now readily be overcome, exhaust steam of higher tension being readily led to greater distances Moreover, such exhaust steam of higher tension can more readily be stored in heat accumulators. The heat consumption, with, say, 60 atmospheres initial pressure and 3 atmospheres back pressure, will not exceed that of the best condensing engines so far in existence At present, in the case of these engines, about 2400 heat units out of the 3,000 actually expended will go to the condenser cooling water, being in chimney coolers expelled into the air or wasted on the heating of rivers and ponds, whereas the high pressure, back pressure engines of equal output will enable the same heat to be used to advantage for heating purposes

Distinctly novel points of view should, in the light of these results, be considered in the linking up of power and heating plants The advantages of high pressure steam are equally conspicuous in the case of reciprocating engines and steam turbines, high-pressure, back pressure reciprocating engines having considerably smaller dimensions and requiring a lower initial outlay than the familiar types of condensing or back pressure engine

Coal Mines to be Developed in China

COAL reported to be of a very good quality has been found at Chiyanchow, Paipuchen, Chili Province, China, according to the *Far Eastern Review* The Pekin Mukden Railway Administration has decided to operate the mine with a capital of $5,000,000 Mex, with the view to making the line independent in fuel supply A newly discovered coal field is also reported in Shantung Province, which is said to contain an immense quantity of smokeless coal Chinese and foreign engineers were engaged in the exploration of the coal field, and the mine is to be developed under Chinese auspices at an expenditure of $500,000

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

A Super-Pneumatic Tube

To the Editor of the SCIENTIFIC AMERICAN:

Since the new postmaster-general sent out his invitation for suggestions for improved transportation I have renewed thought on an idea which I have had in mind for a long time, and that is a gigantic pneumatic tube system, even large enough to admit a cylindrical car for both passengers and mail Have studied on this until I believe it may be the next and most feasible step in rapid transit.

With a groove in sides of tube for projection on car to serve the double purpose of steadying and as brake if counter-resistance of air was insufficient, and a resistance flange designed to overcome the friction problem, with block system to prevent any possibility of cars getting within a certain distance of each other, am sure a far greater speed than any airplane could be obtained, and greater—in fact perfect—safety assured—more perfect safety than any other system, and in no way dependent on the elements.

There would be ample hydroelectric power for air compressors, so no coal would be required So while the first cost would probably be considerable, the operation would be very economical.

With the railroads almost obsolete and little possibility of airplanes ever being safe enough for the general public to have confidence in them, I believe this is worth considering. A. E. MORRILL.

Willimantic, Conn.

An Exchange of Lichens

To the Editor of the SCIENTIFIC AMERICAN:

The work I am engaged upon here takes me over a large portion of Southwest India ranging from sea level to an elevation of 7000 feet and including desert condition and tropical forest with an annual rainfall of 300 inches or more. Consequently I have at my command a very varied flora. I have always been an ardent amateur botanist and flowering plants are a hobby of mine. For some years I have been struck by the very varied Lichen flora of my district and I should be very glad to get into touch with someone who is interested in these plants I should be prepared to collect and forward material under numbers if he in return would send me correct names for my duplicate collection and when a good list had been made I should propose to publish it with all due acknowledgments in the *Journal of the Bombay Natural History Society* or the *Journal of Indian Botany* or both

I should like to do this purely from the hobby point of view and I am looking for the personal element of corresponding and working direct with someone interested as I am in the subject, and not the sending of specimens officially to a museum which I find unsatisfactory

Perhaps you may know of someone on your side of the world who might care to write to me about this If so the address given will always find me

The Agricultural College, RUDOLPH D ANSTEAD
Coimbatore—Lawley Road P O, South India

Industrial Depression

To the Editor of the SCIENTIFIC AMERICAN

Is there no cure for this, and what is the actual cause? We were all advised to work and save to remedy the effects of the waste of war Everybody, nearly, has done so (if cutting off luxuries, wearing old clothes, and generally doing without is saving) There are also bread lines in cities and men strong and willing, unable to get work. It is an axiom that "wealth and money" are "labor or results of work" Then here is "wealth or money" being wasted and refused The demand is always there, the material is there, and the labor is there What is missing? It must be the go-between capital or money In other words, a piece of paper or pieces of metal Surely, human brains can find a remedy for this. During the recent war the human race made an immense effort, perhaps the greatest it ever made—and the purpose—the destruction and injury of their fellow men and destruction of valuable material and property If an effort for that unspeakable purpose can be made and paid for, surely there must be the means to pay in an effort to supply the demands of the human race. There is certainly something seriously wrong with the arrangements. Is it not the medium of exchange? We are unable to barter or exchange our work or goods for others that we want Cannot some of your readers suggest a remedy? Is the whole banking system wrong and the gold standard, or are we to await another war to make things better?

Kamloops, B C ARTHUR SHERMAN

Amos W. Hart: Edward W. Byrn

BY a curious coincidence, there died in Washington, D C, on September 21st, two of the members of the Washington patent bar of longest standing, and both of long connection with the firm of Munn and Co Mr Amos W Hart was in his eighty first year, and until the illness which resulted in his death he had for 54 years been on the regular staff of Munn and Co Of course he was in this office longer than any one else ever attached to it, and we venture the assertion that few business connections stand the strain of years as well as did his The members of the Washington office of Munn and Co are flattered by the idea that Mr Hart was in many respects a remarkable man He had unusual information, rare intelligence, great industry, and extraordinary conscientiousness He was one of the finest of the many representatives of that class of highly capable professional men who prefer to settle into the orderly discharge of the duties of a responsible position, rather than assume the less agreeable task of carving out an independent career It is men like Mr Hart who go farthest toward refuting the impression that one sometimes gets, that a professional man who is content to work on a salary must necessarily be of less than the foremost caliber His authorship of "Hart's Digest of Patent Decisions" would alone establish his professional standing, if his long and honorable career in the office of Munn and Co were not cited at all

Side by side with Mr Hart there sat, for many years, Mr Edward W Byrn, ten years Mr Hart's junior Though not with Munn and Co at the time of his passing away on the same day as Mr Hart, Mr Byrn had spent practically his whole business life with them, prior to his retirement from active practice several years ago He was a man of the same type as Mr Hart In its personnel and in its recollections the office of Munn and Co. is the poorer by virtue of their taking off, and the patent bar of our capital city is a loser only in less measure.

Making Lenses In America

How the Electrically Heated Melting Pot Is Putting Us on a Par with Germany

THERE was a time when almost every telescopic peek at the heavens practically every binocular sighting of a distant object on land or sea, even that interesting glimpse a close up of the stage through opera glasses was a tribute to Germany But not today

There was a time when the whole world looked to the troublous nation for most of its fine lenses for the bulk of its optical glass of every sort In this country when we thought of lenses we instinctively thought of that highly scientific city Jena where dwelt and toiled a painstaking and thoroughly schooled guild of glass workers German trade propagandists saw to it that we did

But we don t today A new American industry with electricity s aid sees to it that we don t

That new industry s real reason for being lies in the fact that when the United States went to war in 1917 the army and navy had to recruit binoculars hand telescopes even pearl mounted opera glasses from the homes of America so that the fighters might see There was no other source sufficiently prolific The supply from the usual sources was cut off

The supply never will be cut off again There is an American optical glass industry which is capable of producing every type from tinkest discs to great lenses large enough and accurate enough for the most powerful telescopes in the world thanks to electricity Right now it is turning out 40 inch lens disks whose quality is not exceeded by the output of Jena or any other glass producing point

A 40 inch lens! Made in America! A few years ago such a thing would have been hooted Nobody in this country attempted the making of such a lens Why try it? Let the German make it

Nobody here could do it principally because even if a sufficiently large potful of sand and potash and litharge and the other elements were melted and stirred at the right temperature—say 2 200 degrees Fahrenheit—nobody knew how to cool it down in a dependable scientific manner

Cooling of glass is a science To cool a huge block such as that from which a 40-inch lens is ground requires weeks and there must be an accurate steadiness of heat such as is little known in most industries If the block cooled faster than a few degrees an hour if it cooled more quickly in one part than in another or if the rate of heat decrease varied much from a required schedule then stress lines would inevitably appear These strains are ruinous to the accuracy of even the most artfully ground lens for grinding and polishing affects only the surface Also the strain might cause the block to crack at any stage of its production thus wasting much expensive effort and material

Formerly, the glass-annealing furnaces of this country were all fuel fired They had their limitations because their temperatures could not always be controlled accurately enough for the making of finest lenses even in the small sizes They were helpless before the task of producing the large ones demanded by modern astronomy

Then came electricity First the batch of glass is melted pressed into soft blocks and then put into electric lehrs for annealing and proper cooling Once it was a good lehr fuel fired which maintained a heat that varied not more than 10 degrees Centigrade from normal The electric holds this variation down to less than 3 degrees In the cooling after the glass is annealed the heat decrease is accomplished with amazing steadiness In one set of exhaustive tests the variations from the desired mean temperature were less than one per cent

This control is automatic A set of thermo-couples, acting as thermometers is put into various parts of the furnace constantly measuring the heat and recording it outside These thermo-couples are connected to heat-controlling apparatus which changes the feed of current so as to hold that heat uniform

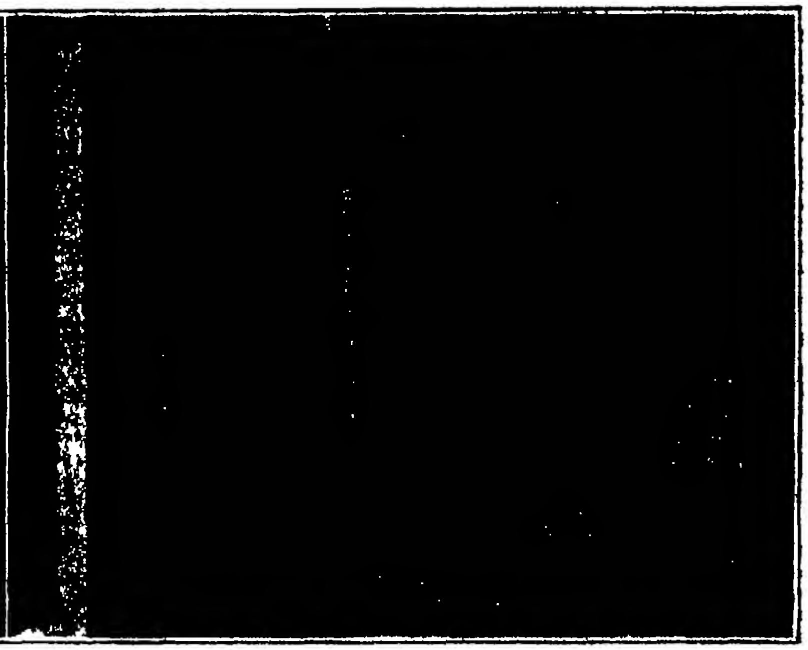
Where exact temperature cycles are needed for a series of anneals on glass products they can be reproduced any number of times with hairline accuracy by operating the control instrument with a time-keeping motor supplemented by a simple cam set to produce predetermined rates of heating and cooling

This sort of equipment made possible the manufacture last spring of the country s first perfect 22 inch disc and more recently of the 40 inch piece in the same factory These glass blocks come from the annealing processes—which take twelve days in the case of the 22 inch disc and twenty eight days for the larger one—ready for the grinding first with coarse abrasives and then with fine and finally for polishing with rouge under a felt tool.

These polished slabs undergo a critical inspection which is the test that approves or condemns the methods used in the furnaces. It is in this inspection that use is found for instruments such as the polariscope to determine whether annealing is perfect and the spectrometer to measure the refractive index of the slab under examination

If the glass fails to meet the tests, the loss is considerable for good optical glass is no common product The even heat of the electric furnace throughout its interior due to electricity s peculiar quality of uniform radiation and the furnace s perfect insulation, its exact control and its freedom from all gases that might contaminate the furnace charge, are proving to be the factors enabling America to meet Germany and its vaunted Jena on an even competitive basis

The electric melting pot that gives well-nigh perfect control of the heating and cooling of the glass



Inspecting the finished product with the polariscope and other instruments seldom met outside the laboratory

Turbo-Generator Operated Five Years with Only a Few Short Stops

FOR five years a 3200 kv-a turbo-generator has been operating in the power plant of the City of Saskatoon province of Saskatchewan, Canada, without a breakdown to mar the continuity of its performance This, while not a record, indicates a sturdy mechanism that carried its load despite the severe handicap of extremes in temperature, which are common in that portion of Canada in which the generator is located, and which might well be taken as sufficient justification for any irregularity of operation that such a machine might show

The unit was installed by the Westinghouse Company in 1914, being put into operation November 24 of the same year Except for a short period in the summer of 1919, it has been continuously available for service. Furthermore the unit was not taken off the load at that time on account of mishap to the electrical units of the machine proper

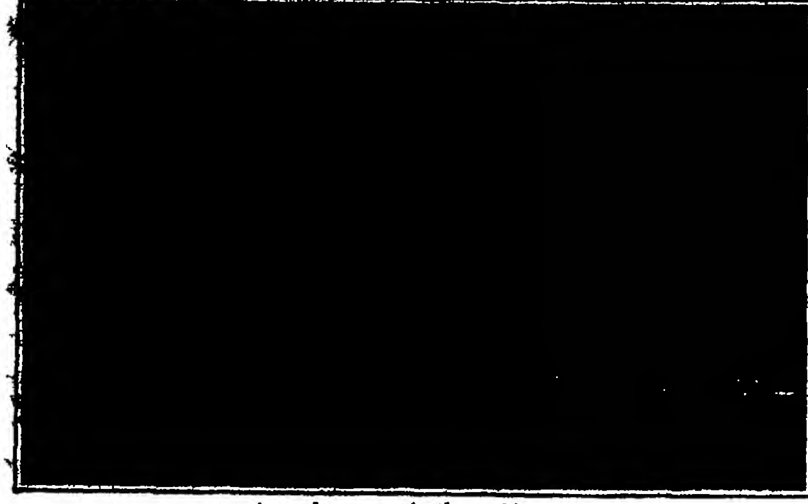
According to the chief engineer of the City of Saskatoon the periods when the unit was not in operation are not on account of non-availability for service, but on account of the load being so light at the time that it could be carried by a smaller turbine.

Other performances are stated by city engineers. In summary, they show that the governor operated between extremes of load which varied from 300 to 2850 kw in perfect control The only portion of the entire equipment that was ever removed was the governor pedestal cap for the purpose of renewing a gasket on the bland runner joint The condenser too, has proved reliable On one occasion when ice shut off the water intake 17 times in an eight hour run no trouble to the tubes or plates occurred under this unusual strain The Le Blanc air pump never has given any trouble with condensing water at a proper temperature, having shown that it was quite easy to run as low as point six from the barometer, at all loads. In conclusion the chief engineer stated that any records of economies of this unit exceeded those guaranteed by the Westinghouse Company

In regard to the graph also prepared by the city officials, two runs of long duration can be noted. The first of these is from October 6, 1916, to April 22, 1917, and the second from June 12, 1917, to March, 1918. In the first run the load factor was 66.3 per cent while in the second it was 46.6 per cent.

An inspection of the unit was made in August, 1920, at which time no replacements were necessary, as no wear was noticeable.

Since that time, the chief engineer states that the unit has been operating satisfactorily and shows indications of an unusually long life.



A smoke screen in the making

From the inside of a smoke screen, looking out

How a Sham Battle Is Fought Today

IMAGINE thirty-eight real torpedoes rushing suddenly at your ship and not an enemy vessel in sight!

That sight was the climax of the spring battle maneuvers of the United States Pacific Fleet which were carried on for several months. During the exercises there was hardly a day during which some new battle tactics were not tried out, but the most dramatic was saved for the last, when a sham battle which included aircraft, destroyers and battleships, took place some fifty miles off the port of Los Angeles, where the fleet is based.

With the location of each branch of the fleet unknown to the others, the seaplanes which acted as the battleship divisions' scouts quickly sighted the approaching enemy—nineteen destroyers. Simultaneously the blimp "B-3," the destroyers' reconnoitering force, sighted the oncoming battleships.

Immediately a smoke screen was laid in which the swift little destroyers could move about unobserved by the battleships. Probably a more effective smoke screen never was laid. With atmospheric conditions perfect, the screen completely covered all nineteen of the destroyers, making them impossible to locate.

Observers on the battleships suddenly saw a splash near the edge of the smoke screen, then a flashing white line in the intervening water, followed by a dull thud. The torpedo had found its mark and hit squarely on the bow of a "battleship." The torpedoes, of course, carried dummy war heads in place of the war-head proper, which carries several hundred pounds of T.N.T. So the battle continued with thirty-eight of the torpedoes emerging from the smoke screen. Several of them found their mark. The battleships managed to avoid many, however, by sharply turning when a torpedo was sighted, so that it passed by. At the end of the fight, it was learned that all four of the big superdreadnoughts had been technically sunk.

This brief account, coupled with the accompanying photographs, will give a brief idea of the literal way in which torpedo battle maneuvers are being accomplished by the United States Navy. There was a time, not long removed, when sham battles were more or less theoretical affairs, in which maneuvers were conducted by text-book methods. Not so with the modern navy. Today Uncle Sam takes out his big and little fighting craft, provides them with all the apparatus of actual warfare, save the actual disasters, and has them "shoot it out."

It is not necessary to emphasize here the difference in the resultant effect upon the real backbone of the fleet—the common sailor. Formerly he was merely the subject of a lot of orders and, at the end of several weeks, learned that his ship had won the sham battle. Now he goes out, he sees actual torpedoes coming through the water at his ship, he sees aircraft flying above him dropping bombs upon it, he sees his ship firing actual shells at targets, he sees the battleship turn and twist to avoid the enemy. In short he sees the results instead of reading a technical report of the effect that might have resulted had all observations and calculations been correct. The result is an interest and a morale of the kind that wins battles.

The latest manoeuvers have been of inestimable importance in many ways. It may reasonably be expected that the practice of simulating actual naval engagements in all their details will become universal in all naval manoeuvers of the future.

A complete smoke screen. There are 19 destroyers in the field of the camera. Can you find one of them? The enemy gunners cannot

Semi-Diesel Engines

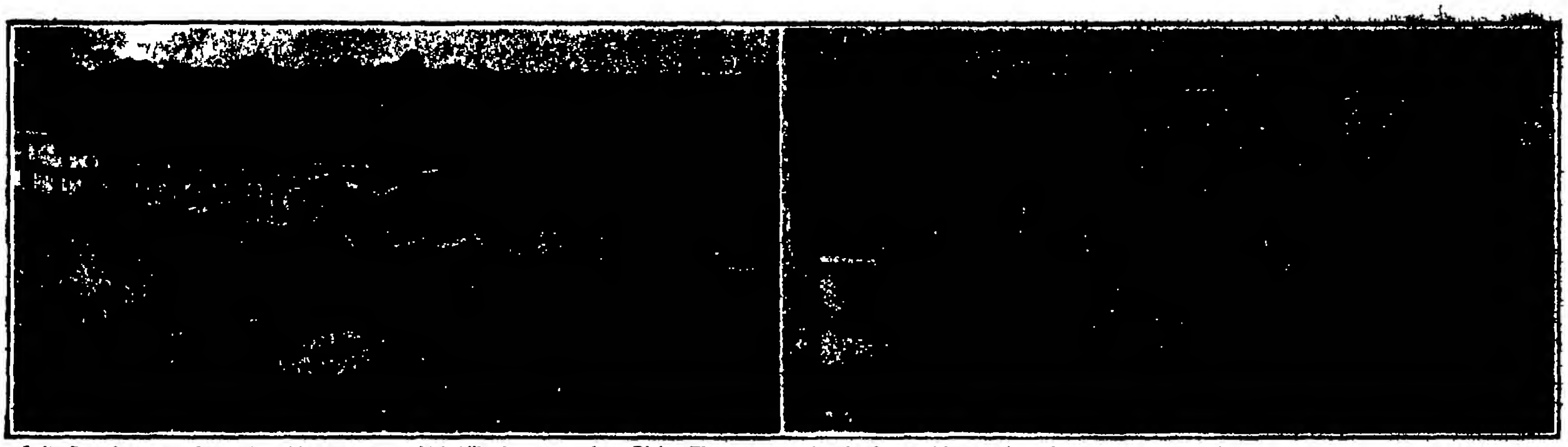
MANUFACTURERS of semi Diesel engines do not intend to leave the field of large motor-ship construction clear for Diesel engine builders, and sets of the former type of 500 h p per engine are now being standardized by two or three firms, states the *Times Engineering Supplement* Very few installations of such power have, however, been made in Europe, although there were many examples in the United States during the war, and the construction of a 2,700 tons ship in Holland equipped with two 500 b h.p. semi-Diesel engines is therefore a step of some significance The engines in this case are of the Bolinder type, and the designers have made a radical departure in at least one important direction Usually with semi Diesel engines of this size it is necessary for the bulbs to be heated for at least half an hour before they are started up This may be regarded as one of the drawbacks of the semi Diesel design, and in order to overcome it the manufacturers have now devised a means of starting from cold Electric plugs of special design are fitted in the tops of the cylinder, and these are heated by the passage of current from accumulators charged from the electrical auxiliary plant Even these large motors, it is claimed, can be started up almost immediately, and another advantage is the elimination of the blow lamps, which are somewhat inconvenient and always a possible source of danger Many manufacturers of semi-Diesel machinery are adopting electric starting devices.

Triple-engined Gallaudet power unit for huge airplanes, which develops a total of 1200 horsepower

Three Engines in One

REALIZING that the future of the passenger-carrying airplane depends very largely upon the development of reliable and still more powerful engines, Edson F Gallaudet, an aeronautical designer and builder of Warwick, R I, has constructed a power unit for large aeroplanes which consists of three Liberty engines geared to a common propeller by means of a clutch mechanism The power unit is shown on a test stand in the accompanying illustration, and its size, as well as the size of the huge three-bladed propeller, may be gathered from a comparison with the men standing about it.

The huge power unit, according to its designer and builder, is of sufficient size and power to assure non stop flights from New York to Liverpool, in 20 hours or less. Two Liberty engines are placed side by side, and a third is placed at the rear The plan is to operate two engines at all times with one in reserve Each Liberty engine of the group develops 400 horsepower The propeller is 18 feet in diameter. This power unit, as well as two others of the same type, is to be delivered to the U S Navy



Left: Spraying water hyacinths with live steam, which kills them instantly *Right:* The way it used to be done—with a costly and unsatisfactory arsenical spray, which failed to take account of the fact that cattle insist upon eating the poisoned leaves

Solving Louisiana's water-hyacinth problem. This menace for a time threatened to put most of her bayous permanently out of the class of navigable streams

Fighting the Water Hyacinth

Clearing the Clogged Waterways of Louisiana and Florida by Means of Live Steam

By Thomas Ewing Dabney

AT last a means of fighting the water hyacinth has been found, a means as cheap as it is efficacious, and the search of government engineers of more than 20 years has been ended

The waterways of Louisiana and Florida that were in danger of being clogged entirely—many were practically closed to commerce during the summer months—are now safe for trade In Panama and India, too, the menace has of late years been assuming equal proportions.

Live steam is the answer to the puzzle Spraying live steam on the tangled, matted surface that broke the strongest steel cables, has been demonstrated a sure way of killing the pest.

The water hyacinth is a native of Venezuela, where it is known as "oreja de mula" (ear of a mule), or "buquelito" (little boat) Its botanical classification is "piaropus crassipes," and it is related to our native pickerel weed family Peticles or leaf-stalks distended with air at the base cause the plant to float after the seed that have fallen to the bottom of streams, sprout and rise to the surface Six weeks later, the plants send up blossoming stems which bear 35 to 45 flowers of exquisite beauty, and produce an average of 170,000 seed a year, which ripen in four to six weeks in warm weather, or hibernate in cold.

So far as can be learned, the water hyacinth was first introduced into the United States in 1884, during the Cotton Centennial Exposition held in New Orleans. It excited great admiration, and visitors carried away plants for their garden pools and ponds In this warm semi tropical climate, the water hyacinth throve amazingly, and quickly filled these limited areas The surplus was thrown into the bayous and was carried by the action of the current throughout the state, where the water hyacinth found conditions peculiarly adapted to its growth More and more it began to clog the streams. So rapid is the growth that a bayou 150 feet wide with only a fringe of water hyacinth on the edges in March will be completely covered, from bank to bank with a tangled, matted mass in June—an almost solid subaqueous crust through which boats can not pass.

As a vast section of southern Louisiana is served by waterways, it is apparent what this means commercially This beautiful pest has been a serious difficulty in the way of developing waterway service of recent years, since the government gave the cause such an impetus through the Mississippi-Warrior barge line.

Sawmill interests along Bayou Plaquemine began to fight the pest in the early nineties. They sent gangs of men up and down the bayou with pitchforks to clean out the bayou and keep the way for navigation open. But by 1896, it was apparent that more heroic measures were needed.

In 1897, an appeal was made to the federal government, and in 1899, the first federal appropriation was made. It was for $25,000

SOME years ago New Orleans had an exposition, in connection with which a few water hyacinths were imported and shown After the show was over, there were requests for these handsome plants for gardens, and they were distributed in this way The result was somewhat similar to what happened when Australia introduced the rabbit For some years an outstanding problem has been the freeing of Louisiana's waterways from the mass of hyacinths, which makes navigation utterly out of the question. Mechanical means are outlawed by the rapid rate of growth of the plants Poison is out of the question, as has been found to the cattleman's cost Now live steam has been suggested, and tried out on a scale which makes it seem certain that the answer has been found This is the story that Mr Dabney tells us here.—THE EDITOR.

A steamboat was purchased and fitted at the forward end with a conveyor four feet wide, which scooped up the water hyacinth and passed the plants back through a series of rollers where they were mangled and discharged upon the bank.

This method was slow and expensive, costing about six cents a square yard. Furthermore, the hyacinth grew faster than the rollers destroyed.

Various acid sprays were then used—nitric, sulphuric, hydrochloric, etc, but they had to be made so strong that the cost was prohibitive.

Crude oil was spread upon the waters and set afire It burned the tops of the plants very effectively, but a new growth sprung up in a week or so

In 1902, a patented poison spray costing three cents a gallon, or enough to kill 12 yards of water hyacinth, was used with considerable success. Then in 1905, the U S Department of Agriculture developed a solution of white arsenic and sal soda, which was used with such signal success in killing the Canada thistle that it was tried on the hyacinth. It cost less than half a cent a gallon to make.

This has been the method followed ever since Boats equipped with spraying tanks, pumps, and hose would be sent into a hyacinth-infested waterway, and would slowly work their way through. Counting labor, it cost about one and three-fourths cents a gallon to apply the spray The plants would wilt and die within three or four days.

If, however, there was a rain, the arsenic solution would be washed off and the work would have to be done over Furthermore, cattle are very fond of the water hyacinth, and many died from eating the poisoned leaves. Cattle owners had to be warned in advance of the boat's coming, to pen their livestock. By many it was believed that the fish were poisoned, but this belief seems unfounded.

This spray did all that could be expected of it—but the government engineers confessed that it could not keep up with the growth of the menace.

In Florida, similar conditions have prevailed. In the Panama Canal, the government engineers have been fighting the inroads of water hyacinth for many years with arsenical spray So choked had the waterways of India become in 1918 that the Indian government sent an expert to this state to study the arsenical method In its native habitat, Venezuela, however, there seems to be a natural foe that keeps the water hyacinth from becoming a pest

John Klorer, city engineer of New Orleans, who for five years had charge of the water hyacinth eradication work of Louisiana, came to the conclusion that the floral pest would eventually choke all but a few of the largest streams of Louisiana "On account of the immense area infested," he said in 1908 before the Louisiana Engineering Society, "it is impossible to exterminate each and every plant by mechanical means or the poisoning methods now in vogue. We must look to plant pathology for a complete riddance The investigating botanist may possibly find some natural enemy to the plant, some parasitic fungus, that could be cultivated and spread among the hyacinths and which would not be a menace to our agricultural interests."

Then came the solution—strangely enough through the suggestion of a layman—Governor Parker of Louisiana.

Since July, 1921, oil boats of the Texas Oil Company had been caught in a hyacinth jam of Bayou Lafourche, an important waterway through the sugar section. One of the company's big boats, the S. S. "Hyacinth," towing a barge equipped with poison-spray apparatus, was sent to the rescue Steel cable after steel cable was broken as the "Hyacinth" sought to force its way through the matted mass of roots and leaves.

G Donnaud Bentley, of the Texas Oil Company, was discussing the problem some time later with Governor Parker at Baton Rouge.

"Why not shoot live steam on the water hyacinth?" suggested the governor

It had never been thought of The idea was given a try-out. It worked. The first application was made in August. The tops of the lilies immediately wilted. Hotter steam was thrown on. The effect was magical. And the boat, shooting broadsides of live steam, forced its way through the growth at the rate of a mile and a half an hour At one place, a solid mat of hyacinths, nine miles long, was encountered.

This was done with improvised steam-throwers. Now plans are being made to set the steam nozzles flush with the water, so that the roots, bulbs and all will be destroyed.

That is the situation today. Sufficient work has not yet been done to determine the average cost of operation, but it is obvious that the steam method is considerably cheaper than the spray method. It is more rapid, and rains and heavy dew don't hold it up, thereby giving the water hyacinth another handicap in its remarkably rapid growth. There is no wake of poison to menace the livestock of the region.

A Model in Appearance and Production Alike

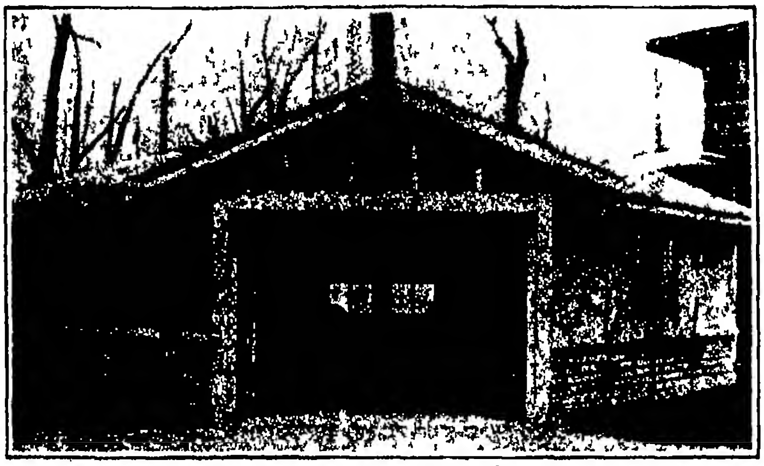
SO skilled are the average model makers of today that they can duplicate virtually any piece of machinery, ship, factory or whatnot on a miniature scale They work with plaster, small castings of brass and lead, carefully and ingeniously applied paint, and so on; but the very nature of these materials renders the usual model a rigid, lifeless proposition. It is one thing to secure realistic effects, and quite another to secure such effects and actual operation as well.

This model paper-making machine turns out paper from wood pulp, duplicating the operation of a full-sized machine

A happy combination of realistic appearance and actual operation is represented in the little paper-making machine which was recently shown at a graphic arts exposition in Chicago. This machine, which is depicted in the accompanying view, is a real paper-making machine in every sense of the word. The average paper-making machine is more than 200 feet long and weighs several thousand tons. The model paper-making machine is less than nine feet long Some of its bearings are as fine as those of a watch This machine carries out every operation for the making of paper, from the time the pulp is fed to the grinder and through every process to the finished paper, which is rolled up at the left of the illustration The paper comes out in continuous strips four inches wide

A Two-Car Garage with a One-Car Doorway

AN angular garage of the type shown in the accompanying illustration has many advantages. First of all, it takes care of two cars—one in each wing, yet the doorway is only wide enough for one car at a time, hence considerable space and expense is spared in such a building Each car can enter or leave the garage without disturbing the other car, always providing, of course, that both cars do not attempt to enter or leave at the same time.



The angular garage A two-car garage with a one-car doorway

World's Largest Tent Hangar

ENVELOPING an area of 180 by 80 feet in dimensions, a tent hangar recently erected by the United States Air Service at McCook flying field, Dayton, Ohio, has been awarded claim to supremacy as being the largest in the world With a clear opening across the front, this tent hangar is sufficiently large to accommodate three Martin bombing machines. Its value to aircraft service is contingent upon its ability to withstand the weathering test satisfactorily

This tent hangar, erected at McCook Field, is said to be the world's largest

Turning Live Steam Into Weed Destroyer

AN invention which has proven to be one of the greatest labor saving devices for railroads in recent years is the weed destroyer recently patented by Harry M Williams, veteran locomotive engineer of the Missouri Pacific Railroad, and the late J W. Dean, general superintendent of that line.

The machine consists of a system of pipes installed on a forty-foot flat car and used in connection with either a saturated or superheated locomotive. Superheated steam from the locomotive is applied direct to the vegetation, snow or ice, at a temperature ranging from 550 to 650 degrees, Fahrenheit

A weed destroyer for railroads, which makes use of the destructive action of live steam

The main burner of the apparatus is installed under the center of a flat car, with burners or wings extending out from each side of the car to any distance desired Curtains of asbestos cover the wings and confine the steam to the surface being treated, thereby insuring a maximum degree of heat. The wings are raised or lowered by means of air hoists, thus avoiding striking switch stands and other obstacles along the track.

In connecting the burner to a superheated engine, the communication between the boiler and cylinders is shut off with a gage valve and steam pipe Two auxiliary valves are arranged, one to operate the locomotive and the other to furnish steam for the destroyer All work is performed with the equipment backing for the reason that the extreme heat and the facilitating the immediate piping connections from the superheated unit to the burner car which saves heat units

Three pipe lines are extended from the locomotive, one $2\frac{1}{2}$ inch pipe extending to the main burner and one $1\frac{1}{2}$ inch pipe to each of the two wings A network of three-quarter inch pipes is fitted on the wings, in which there are $\frac{1}{8}$-inch holes about six inches apart, drilled staggered, through which the jets of steam are forced

These machines have proven economical of operation, cleaning the track of vegetation at a cost ranging from $8 to $12 per mile From twenty to twenty-five miles of track may be treated a day with the destroyer It is also used by several of the railroads to melt snow and ice from around switch stands and frogs in larger terminals in winter

Do Moths Use "Wireless"?

BY what means is the male moth acquainted with the fact that the female is asking for his attentions? Certainly it is not by *scent for the males travel down the wind* to the place where the female is just as surely as they will fly into the breeze Another suggestion is that the males are attracted by sound which is inaudible to human ears. That there is nothing in this suggestion has been entirely disproved for the female Vapourer has been enclosed in a sound-proof box and still the males come to her with unerring instinct

It has lately been suggested that these insects communicate with one another by means of "wireless." It is said that they do this by means of electro-magnetic waves of exceedingly short wave length Well established facts seem to lend color to the suggestion. Probably the most sensitive organs that moths possess are their antennæ. The antennæ of the female, who is the transmitter, differs in pattern from those of the male who is the receiver This fact agrees with the design of wireless instruments. Another curious point is the behavior of the male as he nears the place where the female is stationed Often he will alight in a very uncertain manner moving his antennæ about much in the same way that a wireless operator will swing his direction finding frame in order to discover the quarter from which the signals are coming —By *S Leonard Bastin*

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

This dish of gauze is of great aid to the chemist

A Novel Laboratory Vessel

THE curious illustration that accompanies this text represents a dish of great value to the chemist in the determination of solid matter of any fluid. It consists of a fine mesh wire gauze resting by means of supports in a dish and corrugated in such a way that it presents two surfaces of approximately 200 square centimeters each. Due to the close proximity of the grooves these can exert a strong capillary action so that the gauze will hold at least 5 cubic centimeters of any liquid without any of it going through the meshes.

Due to this large surface and to the effect of the meshes and corrugations in maintaining a wide and even distribution of the liquid, dehydration is entirely uniform and is carried on by the action of the atmosphere on both surfaces of the gauze, any one part of the liquid being subjected to the same drying condition as any other.

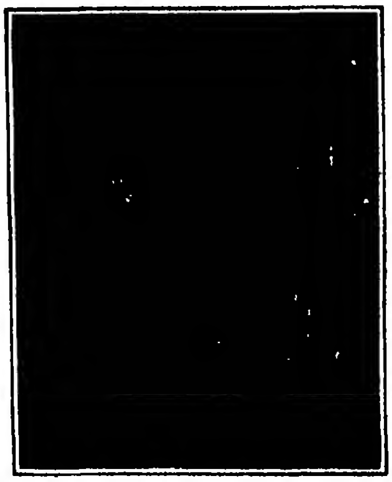
When a dish alone is used with an area usually of about 20 square centimeters the solids when secured are distributed irregularly over the bottom and uneven heating results attended by charring in the case of saccharine and other organic liquids. If the liquid is distributed over sand, asbestos or pumice stone in a dish or cylinder that which reaches the lower layers is subjected to different heating conditions than the rest, also unavoidably more of the liquid will be gathered in some places than in others. Even with stirring errors due to ineffective and uneven distribution cannot be entirely avoided. All these substances require thorough preliminary treatment before they can be used and even then are somewhat limited in their application by the chemical nature of the liquid to be distributed over them. With the gauze-dish the troublesome preparations and precautions required by these materials are entirely avoided, and the liquid comes into contact only with a material of a well tested unreactive character. In addition to these drawbacks the absorption of hygroscopic moisture from the air during weighing is considerable when sand etc is used. This may be a source of error even with the most painstaking precautions. With the gauze dish the absorption of moisture is comparatively slight.

Trucks of Long Life

SOMEONE guessed once upon a time before we really knew what trucks would do that the life of a motor truck was about five years and in arguments both for and against the power wagon this life period is always coming to the front. Along the line of longevity, it is significant to note that entire fleets of motor trucks bought more than five years ago are still in operation and delivering the same efficient service as that required of new machines. A sight seeing bus company of Chicago and New Orleans has five very early models still running continuously. They are all motor buses. One is 19 years old, another 18 years another 17 years old, and the remaining two are 14 years old. Another New Orleans Company interested in a similar enterprise is still running five old buses regularly ranging in age from 8 to 13 years. A soap maker of Brooklyn has a fleet of eight old trucks between the ages of 8 and 13 years. A contractor of New York operates thirty trucks of 5 ton capacity each. The majority are over 9 years old while many have been in service for 11 years. A hauling contractor in Paterson New Jersey recently sold a 5 ton machine that he had run for 10 years without a single overhaul. A large department store of New York has 15 old models in its fleet of 62. They are from 8 to 12 years old. A New York fleet operator reports that his 30 old machines between 8 and 10 years old are still giving service as good as could be expected of new trucks. A New York sugar refinery operates a fleet of 15 trucks all of which are over 8 years old.

Photographer's Portable Lighting Apparatus

THIS equipment is put up in very compact form in a specially constructed suitcase style of carrier. Set up on a rod with tripod base it can be opened and put to use wherever it is possible to get electric light connection. The muslin screen is for the purpose of obtaining a soft effect when the apparatus is used in portrait photography.



This light will work wherever there is current

Wholesale Testing of the Life of Light Bulbs

UNCLE SAM has rigid requirements as to the quality of his office equipment that may ultimately figure in making the wheels of Government go round, and even the electric-light bulb is no exception to the rule. Life tests are administered by the National Bureau of Standards and if the lamps fail under prescribed specifications they are very promptly discarded.

Specimen lamps are selected by Government inspectors. They are burned on the racks to determine their life in hours to 80 per cent of the initial candlepower or to burn out if above 80 per cent candlepower. From these experiments is determined the acceptability of lamps supplied under contract to various departments of the Government.

An Adjustable Spotlight for the Closed Car

THIS spotlight may be operated from the driver's seat within a closed car. The long supporting rod is in two pieces which may be taken apart for installation purposes. It passes through the slightly open windshield. The lamp is turned by means of the handle connecting with a shaft running through the supporting rod. This device can be used as equipment on any car and can very quickly be put in place. Its advantages especially in winter are obvious.

A spotlight that can be operated from within the sedan or coupe

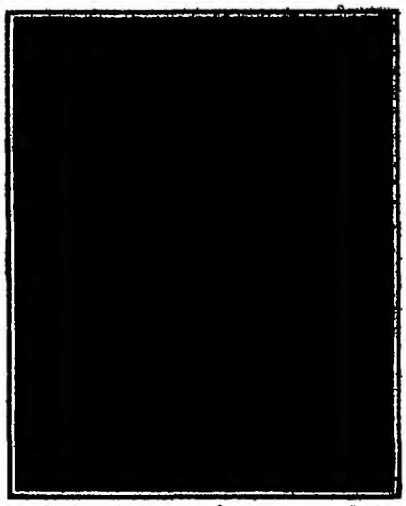
A Pneumatic Grease Dispenser for the Garage

THROUGH the medium of compressed air taken from the ordinary receiver maintained at all first-class garages and automobile service stations for the inflation of tires this device may be effectively operated for the dispensing of plastic or semi liquid oils or greases, taking them directly from their original containers if so desired, and delivering them to transmission gear casings differential gear housings, and the like.

In addition to providing a simple method of handling of lubricants this apparatus also combines the elements of speed, cleanliness, freedom from waste and automatically and accurately measures all materials used.

The mechanism is simple and virtually fool proof. It consists of two ordinary cylinders with pistons, one for dispensing the lubricants and the other for pulling the main piston rearward, and recharging the main cylinder with lubricant. The entire operation both dispensing and recharging, is controlled by a simple quarter-turn of a single three-way valve.

The lubricants can be dispensed from a nozzle of convenient size and shape at



A device that uses the compressed-air supply to deliver grease to gear housings

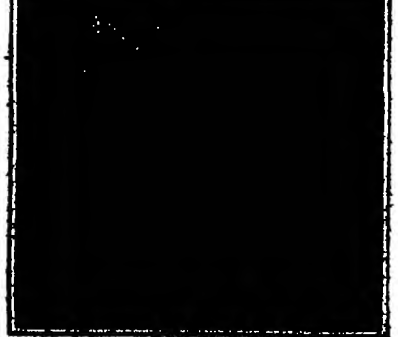
the end of a flexible hose of any desired length.

The measuring device is adjustable in accordance with the grade of lubricant being used and consists of an entirely visible scale on the surface on the rear cylinder. Combined with this is an audible signal composed of a bell which can be set to ring automatically after any given quantity of the lubricant has been dispensed.

The apparatus is very compact, and may be installed as a stationary or portable one.

Studying Glider Flights with the Motion-Picture Camera

THE extensive glider flights recently made in Germany have been followed with no little interest by the leading German aircraft designers and constructors as well as by Fokker, the famous Dutch aircraft constructor, whose name became so well known during the war. In the accompanying view we have Fokker studying the glider flights by means of a motion picture camera. It will be noted that Fokker is using an odd camera support which comprises a small platform for holding the camera, and a pair of hooks that fit about the shoulders. Obviously, such an arrangement permits of much greater freedom in filming airplanes, gliders and other rapidly moving objects, than does the usual tripod. We note by the photograph that Fokker is using a Debrie camera, which is of French manufacture and weighs about 15 pounds.



Fokker, the well-known Dutch aircraft constructor, following glider flights with motion picture camera

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Uncle Sam's Big Camera

(Continued from page 258)

cially-designed rod which grips the edge of the paper without injuring it. The construction of this plate-holder makes it possible to copy directly from tracings and whatnot and renders easy the making of positives and transparencies—those beautiful pictures on glass for which the Geological Survey is famed.

A curtain made of nearly transparent material wound on a spring roller at the back of the frame is employed to get the desired lights and shades. Another unique feature of the copy holder is the centering device. This consists of four cords, two of which cross the plate vertically and two horizontally. They are manipulated by a slide at the top of the holder which moved toward either end of the frame gives the exact margins for the sheet to be photographed. A slide rule perfected for this machine, determines at once the size of plate to be prepared for exposure without the usual measurement on ground glass.

Focusing is a simple process with this giant among cameras. There are two scales, one on either carriage, on which the degree of reproduction is indicated and the two carriages are moved until the figures read alike on both scales. That is the thing in a nutshell, but in detail it is worked out like this. An electric contact is set at the desired point on the scale of the copy holder carriage which with another contact is then put in motion. When the two points meet and the circuit is completed a small incandescent lamp flashes the signal to stop that the copy holder is in exact position. Should it happen that the carriage runs past the point of contact, the operator uses a fine adjustment hand wheel to bring it back, when the little lamp will again send out its glow. The photographer then turns his attention to the primary carriage with the lens and prism. He sets the scale corresponding to that on the other bar and starts the motor which drives the carriage along until the proper figure is reached again using a hand wheel for accurate adjustment. It is all so easy that the picture maker can be up and away to another job while his friend with the ordinary copying camera is fussing and fuming over bothersome details.

Reversible motors drive the two carriages with astonishing ease and precision. As has been stated the copy holder is always in correct alignment with the lens and plate-holder so that the camera front never budges a hair's breadth unless the copy holder moves in the same direction but both can at once be driven forward or backward as occasion demands.

Cooke lenses of 31 and 42 inches focal length are used in combination with a Cooke prism. These attached to a heavy brass plate, will make a picture large or small. As accuracy is the paramount consideration the optical parts must be in just the right position and absolutely rigid. Plate and copy holder are plumb or if not, can be made so by screw movements on each part, while the prism is brought into alignment by a thumb screw passing through a strong brass bracket which runs out beneath it from the frontboard.

And this completes the description of the biggest of all metal cameras—a thing of mechanical perfection which has earned Uncle Sam a place in the sun. While you are meditating over its astounding performances a servant of the people is preparing for another picture. He frets not with the cumbersome stand of the older machines but moves quickly and freely around all the parts. The result may be a classy map of the known oil fields or a chart of mineral production or perhaps a map of the United States from which some little tot in a small town will get his first lesson in Americanism.

SCIENTIFIC AMERICAN

now a monthly journal

Before laying aside this issue we bid you—as old friends and subscribers of Scientific American—to pause a moment at the significance of the publishing change announced in this and previous issues.

Your Scientific American is to become a monthly publication, by consolidation of the four weekly issues and in combination with the present Scientific American Monthly, the resultant an 80-page periodical of monthly publication.

In the new, the Scientific American editors have guarded all of the best features and distinguishing qualities of each publication; and we now ask our friends to turn to the new Scientific American—a bigger and better journal, yet maintaining all the high standards that have given to the Scientific American such world-wide approval.

The change has been made for you—to better serve you, and in the more ample space and time of the monthly periodical we shall be able to present the finest and most complete digest of scientific happenings in the world.

The New Price Is $4 Per Year

A very material reduction in subscription price has been made possible by the publishing economies of this combination. $4 is now the annual subscription price for the new Scientific American. Compared with the former prices of $6 for the weekly and $7 for the Monthly, this small subscription quotation gives evidence of our efforts to effect a better periodical at a far lower cost to the reader.

We welcome your renewal subscription. The first issue of the new monthly will be November, 1921—if your subscription to either the present Scientific American or the Scientific American Monthly extends beyond October, adjustment will be made.

To be a reader of Scientific American is to be thoroughly and accurately informed

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THE AVIATOR'S TELL-TALES

SCIENTIFIC AMERICAN

A Weekly Review of Progress in

INDUSTRY · SCIENCE · INVENTION · MECHANICS

MAN MADE LIGHTNING ONE-MILLION VOLT SPARK CRASHING ACROSS A NEEDLE GAP — [See page 268]

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Our Last Appearance as a Weekly

THIS issue marks the last appearance of the SCIENTIFIC AMERICAN as a weekly. On October 20th there will appear the November issue of the new monthly SCIENTIFIC AMERICAN, combining within its many pages the leading features of the former weekly edition and the former monthly edition.

We feel certain that the November issue of the new monthly SCIENTIFIC AMERICAN will more than prove the wisdom of this momentous change. As we have already stated in past announcements, the appearance of our former SUPPLEMENT as a monthly periodical, after appearing as a weekly since 1876, was greeted with such enthusiasm and met such a favorable reception that we were urged to change the SCIENTIFIC AMERICAN to a monthly journal. This we have done—and more; for, as already set forth, we have combined the best features of both the weekly and the monthly editions into one periodical—the new monthly SCIENTIFIC AMERICAN.

Such economies as may be effected in combining these two former periodicals are being turned back to the subscriber: the new yearly subscription price is $4.00 a year, as compared with $6.00 for the former weekly edition and $7 00 for the monthly edition, or a total of $13.00.

Look for the November issue of the new monthly Scientific American, out October 20th

SEVENTY-SEVENTH YEAR

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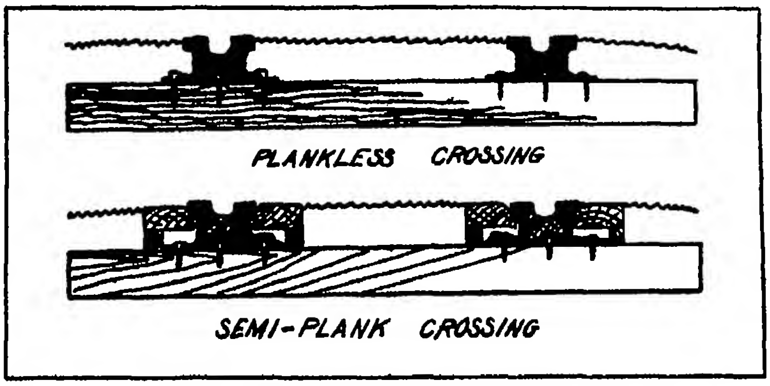
VOLUME CXXV NUMBER 16] NEW YORK, OCTOBER 15, 1921 [15 CENTS A COPY 20 CENTS IN CANADA

Eliminating the Planked Railway Highway Crossings

By E. R. Mundorff

BECAUSE of the ever-increasing cost of lumber and repairs there is an increasing use of substitutes for planked railway highway crossings. Railway maintenance engineers are not only confronted with the problem of the increasing cost and the scarcity of lumber, but are giving attention to the desirable qualities of substitutes, such as drainage and elimination of rail joints.

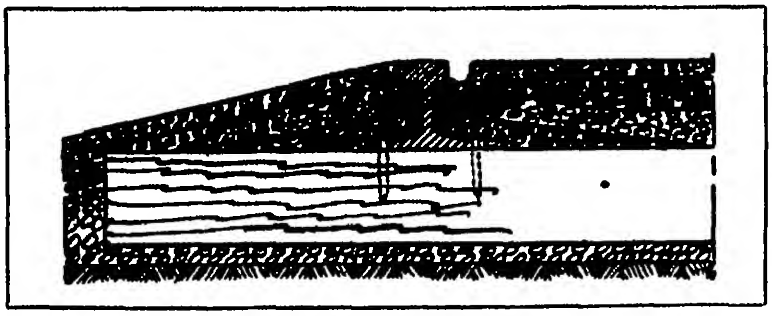
A plankless crossing has been developed on the Lehigh Valley Railroad, the construction of which causes all ballast and dirt to be removed down to the bottom of the tie for the full width of the roadway Such ties as are not good for at least three years of service are replaced, while tie plates are installed where not already provided. The track is then thoroughly tamped and put in first-class condition for line and surface. In automatic signal or electric circuit territory the rail is insulated on all sides by the application of a penetration asphalt or some similar insulating material. The space between the ties and between the tracks is next filled up to the under side of the ball of the rail with clean stone ballast, well rammed and compacted. A mixture is then made up of an oil binder and a good grade of clean stone screenings containing particles of stone up to ¼-inch in size, but with the fine dust and dirt screened out. The mixture thus made is spread over the surface of the road, thoroughly rolled or tamped to the level of the top of the rail No provision is made for a flangeway, the action of the wheels along the rails being depended upon to create and maintain their own flangeway



New crossings on Jersey Central R. R.

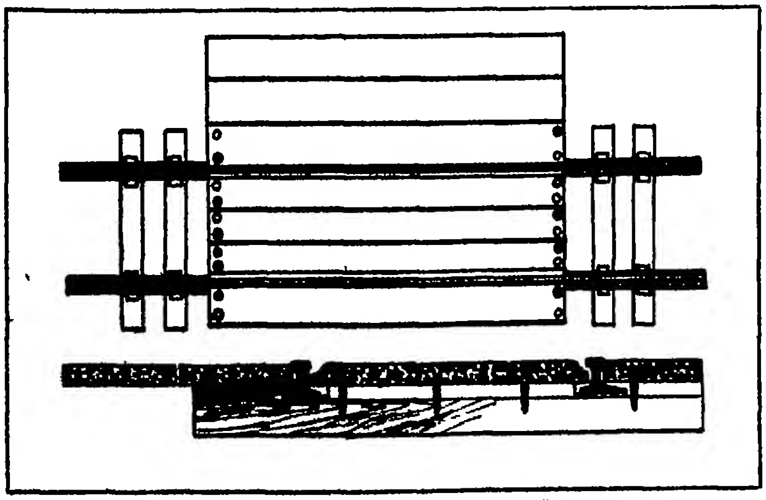
One of the recent developments in the line of plankless crossings is a form of construction which gives a crossing with a good wearing surface and a permanent flangeway, and in addition acts as a seal against the entrance of water to the roadbed Two classes of material are used, one a bituminous cement or binder, and the other a prepared and vulcanized mixture of which the crossing surface is built. In preparing for an installation of this character all ballast and so forth is removed down to the level of the top of the ties. Rail joints are then eliminated, either by the rearrangement of the rail or by the use of extra long rails, and the track is put in first-class condition as regards ties, line and surface. The ballast is then penetrated with the above mentioned bituminous cement or binder, which is applied as a light fluid which hardens under the action of the air to an elastic solid, completely filling the interstices of the ballast. The tops of the ties and the rails are then swept clean of dirt or dust, and the sides of the rails, the tops of the ties and the surface of the ballast are thickly coated with the filler The crossing proper is built up of layers of the surfacing material, separated by thick coats of the filler and carried at least four feet from the rail on the approaches, while the center, or parts between the rails, is built up of a tapering layer of the prepared bituconcrete with ballast on this, after which a top dressing of binder is applied, and then about two inches of the surfacing material. This outer material is applied hot and then thoroughly compacted.

The surfacing material is composed of 20 per cent of ⅝ inch-to-dust trap rock, 20 per cent of denatured hardwood fiber mixed with 30 per cent of impalpable mineral dust colloidally suspended in 30 per cent of 99.1 per cent pure bitumen and normal 50 to 55 penetration. The entire mass is then vulcanized by sulphochlorination to form a sort of synthetic rubber The hardwood fiber, denatured by extracting its sap acids and cellular tissue, forms the reinforcement of the surfacing material through its ability to absorb the preservative binder which, after vulcanizing, gives a mass strengthened in a manner not unlike that of reinforced concrete Being somewhat similar to rubber in its elastic quality, this structure is kept "live by the vibration set up by trains passing over the crossing and thus shows no tendency to break away from the rails.



Section of a bituminous bound crossing

In recent compressive tests on a 12-in. cylinder 6 in in diameter the filler of the aggregate was found to have more strength than any other part of the aggregates, the trap rock content breaking in two in each test before separating from the filler, while a sample, measuring 3 ft long, 8 in wide, by 2 in thick, supported at the ends under ordinary room temperature, bent double of its own weight before cracking



Concrete crossing on Pennsylvania R. R.

Seeds and Age

IT is, of course, a well known fact that the capacity of seeds to germinate tends to decrease with age In some cases germination capacity falls off very rapidly, in other cases it remains high for a number of years after the seed has been harvested Among vegetable-garden crops parsnips afford an example of seeds whose germinating capacity soon deteriorates, even so short a period of one year sufficing to reduce the percentage of germination to a relatively low figure Plants of the cabbage tribe, turnips, etc, retain their germinating capacity longer but at the end of two or three years it will be found to have become less than it was in the year of harvesting The seeds of peas and beans suffer less from the effects of keeping and may give quite good results after three or more years. Needless to say, the power of seeds to retain their capacity to germinate varies not only with the variety, but also with the nature of the harvest and with the conditions under which the seeds are stored. A poor harvest year generally means in this country one in which seed does not ripen thoroughly, that is, does not dry off completely, and such seed generally shows a relatively low initial power of germination and poor "keeping" properties. Conditions of storage also affect the keeping properties of seed. If the air is either uniformly damp or subject to marked alternation of dampness and dryness, the germinating capacity falls off rapidly That this is the case may be easily understood when it is remembered that seeds are very hygroscopic —that is, readily take up water when exposed to a moist atmosphere It is, therefore, necessary if for any reason it is desired to keep seeds for a long time to put them in sealed bottles or jars, and to store them in a cool place. It follows from this that a good general rule is to sow seeds the year after harvesting This rule, however, is one which admits of numerous exceptions. For instance, some seeds —e g, Primulas—germinate better if sown before they are fully matured than they do if sown after their fruits have completely ripened. — *Abstract from Gardeners' Chronicle* (London) July 1, 1921

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Damaged in Transit

ON another page of this issue Mr H D Brown has occasion to refer to the unfortunate fact that a sum sufficiently large in itself to arouse the imagination if it were mentioned by itself, may become altogether insignificant in the presence of a greatly larger quantity The aggregate savings of the Bureau of Efficiency are by no means a negligible sum of money, but when we place them beside the total of Government expenses for the year, they are so dwarfed that Mr Brown feels it necessary to say a word in extenuation of what might otherwise be taken as a very poor showing for his Bureau

Another instance of the same sort comes to our attention this week The railroads of the United States are just about as much embarrassed financially as is our central government The sum of $100,000,000 would seem large enough to insure that its wasting would make a dent in any bank roll, and that its saving would improve the financial standing of any Croesus. Yet when it is compared with the figure of five millions that represents the gross operating income of our carriers, it almost seems as though it were not work talking about. Nevertheless it is well worth talking about, where income and outgo strike so close a balance, a hundred million dollars might easily make all the difference between bankruptcy and solvency, even if it does represent only one-half of one per cent on the aggregate capitalization of twenty billions.

The figure of $100,000,000 named above is the amount paid out in 1920 by all our railroads on account of shipments lost or damaged in transit. As a matter of fact, the payments were somewhat more than this but we are dealing with round numbers, and not with the expert accountant's tabulation down to the last penny Some loss is of course unavoidable in handling such a volume of business as goes over our roads. But the figure of $100,000,000 is susceptible of heavy decrease

As a matter of fact, on some roads at least, great improvement has been effected. The Pennsylvania system has been as active as any other in the endeavor to reduce this sort of loss. Its executives point out that one reason for the bad showing of recent years has been the general backsliding and loss of morale of the war period and the years immediately following That they are making real progress in impressing upon their employees the mutual benefits of cutting down the damage account is indicated by the fact that such liabilities for June 1921 show a decrease of practically 50 per cent as compared with June 1920—a figure out of all proportion to the drop in traffic which is admitted to have taken place in this interval

It is pointed out that so far as the immediate responsibility of the roads is concerned damage to shipments falls under two heads—rough handling and bad stowing In the former category there must always be some difference of opinion as to how much of the damage is due to actual unnecessary roughness, and how much to poor packing The railroad's only salvation here is to educate its agents at receiving points to reject all packages that are not in a condition to withstand the reasonable hazards of the journey for which they are billed. The matter of bad stowing the carrier has within its own control—save for the slight reservation that a collection of less-than-carload lots cannot always be assembled in a car in such a way as to be absolutely tight

The marked success of the drive upon these two elements of the situation convinces the Pennsylvania heads that other drives on similar lines touching other features of freight claim prevention are desirable in the near future. Perhaps the largest single cause of loss lies in pilfering—if indeed such a word can be used in connection with the highly organized looting of freight cars in big centers like New York and Chicago. Presumably all theft from freight cars on the line and at stations could be prevented, but at a cost that would be prohibitive. The railroads must look upon this as a commercial proposition, and prevent theft only to the degree where the cost of permitting it exceeds the cost of prevention The whole thing represents a problem whose solution is difficult, but the elimination of the crooks from actual employment by the railroad, and the education of the trainmen and station men to realize that it is to their interest to prevent thieving, would go a long way toward the prevention of large organized looting of the cars.

New Records in Speed and Altitude

ALTHOUGH the advance of commercial aviation is slower than most of us could wish, there is no lack of progress in the laboratory and the experimental workshop. Proof of this is found in the truly astonishing records in the directions of speed and altitude which have just been made, one in France and the other in America It will be remembered that the last record for speed was set by the French aviator, Lecointe, in the annual race for the Gordon-Bennett Cup, and in some later trials in which he was officially timed as travelling at a speed of over 190 miles per hour, and later, at a speed of 202 miles per hour A dispatch from Paris states that, in testing out the airplane which he used in the race for the Deutsch Cup, he exceeded his former speed by travelling at a rate of 206½ miles per hour Just what this means perhaps can best be appreciated when we remember that an express train, when running well above its average speed, is making from 85 to 90 feet per second. So, the next time the milestones are slipping by your Pullman car at the rate of one per minute, you may reflect that Lecointe, in his airplane, was moving approximately three and a half times as fast as that. Yet this does not by any means mark the limit of possible speed for the airman. Further refinement in the plane, particularly in the streamlining of the body, is still possible, and as for the engine, he would be a rash prophet who predicted that even in such efficient motors as the Liberty and the Hispano-Suiza we have reached the limit of mechanical or thermo-dynamic efficiency

Even more notable than the speed attained by the Frenchman, we are inclined to think, is the really stupendous altitude attained at McCook Field by Lieutenant John A. Macready, the test pilot for the Army, at that justly celebrated center Taking out the same La Pere biplane which was used by Schroeder when he set a record of 38,180 feet in 1920, Macready climbed until his altimeter registered 41,000 feet. Macready was in the air for 1 hour and 47 minutes, all but the few minutes consumed in his rapid descent being used in steady climbing He states that at 39,000 feet, ice formed on his oxygen tank, but he pressed on until his gage registered 41,000 feet, when the engine "coughed and died."

It is needless to say that both man and machine were furnished with special equipment for this test, the engine being fitted with the supercharger already described in the SCIENTIFIC AMERICAN, which feeds compressed air to the carburetor at the same pressure as at sea level, and insures a sufficient supply of oxygen The pilot was clad in the heaviest furs, his suit being electrically heated throughout. Unlike Schroeder, whose eyeballs were frozen and who spent several days in a hospital after his flight, Macready, thanks to the equipment provided, experienced no discomfort whatever and alighted unaided from his machine. Macready's instruments were calibrated by Lieutenant Patterson, Chief of the Technical Data Section of the Field, and the official altitude was given at 40,800 feet.

Consider what this means. At 29,060 feet, or thereabouts, the machine would be level with the top of Mount Everest and, having thus reached the "roof of the world," the machine climbed over two miles above it, so that, when the engine died and Macready pointed the machine down for its swift return to the earth, he was within about 1500 feet of being eight miles above sea level.

Something New Under the Sun

IT must be about three years ago since we were exposed—with no unhappy results, we are glad to say—to the Government-automobile game. A good friend of ours dashed in upon us one fine morning in a state of tremendous excitement. Automobiles which had been purchased by the Government for use in France and which had been left stranded by the sudden cessation of hostilities were lying by the thousand, crated for shipment in slightly knocked-down form, in the railroad stations, shipyards and warehouses of Newark. We gathered the general impression that ordinary pedestrian traffic in the Jersey metropolis was seriously impeded by the accumulation of these cars; that Newark was simply oozing crated automobiles at every pore, that the street cleaning department would have to sweep them into the Morris Canal and open the sewers if something were not done about it at once. They were accordingly to be sold—cleaned out—butchered—practically given away. If we wanted to get in on the good thing, we need only be prepared to produce on instant demand at any time within the next ten days a check for some such sum as $300—the exact amount slips our mind but it was in this general neighborhood. It was going to be a case of instant action, it was not so stated in direct words, but the presumption seemed to be that our telephone might ring at two o'clock in the morning with the glad tidings that now was the moment. The thing had to be handled with a certain amount of finesse, because theoretically the cars were being auctioned, the immediate beneficiaries of the supposed auction had to handle them in lots of a hundred, the buyers of the hundreds were selling in units of ten, through the formation of clubs of individual buyers, our informant was just one remove from the organizer of one of these clubs, who was in direct contact with the source of supply The tenth man might be secured at an instant, and at that instant all ten would have to produce the money and receive their cars, put them together, and drive off.

We must confess that for a few days we were all a flutter After that, each report made the thing look less rosy With each repetition the tale grew more complicated, and the transaction developed more intermediaries. Finally it attained a parity with the juicy bit of gossip that is retailed with the assurance that the narrator had the information direct from a close friend of the nephew of his employer's sister-in-law's laundress, who overheard a conversation in the street car wherein the talker had explained that a friend of a close acquaintance of the landlord of the boon companion of the proprietor of his favorite restaurant had had a first-hand tip from a man who was in intimate touch with a casual acquaintance of a third cousin of the fiance of the secretary of the person about whom the delicious morsel was told. We eventually reached the conclusion that the pretty tale was wholly a myth.

It now develops that it was anything but a myth to some of the people who took stock in it. The yarn was pretty general throughout the country, the storing place of the cars being varied to suit immediate needs; but as a general proposition the prerequisite was that the intended beneficiary of the offer contribute an initial payment of $25 to meet the cost of an "option" on his car Why this particular detail was overlooked in our own case we do not know; there certainly was not much nourishment for the perpetrators of the fraud in its absence.

Our reversion to the subject at this time is caused by the fact that after a two years' relapse into somnolence, the same old game is cropping up again in various parts of the country, and "options" on Government automobiles left over from the war are again being peddled at $25 and $50. We have no doubt that the Spanish-prisoner, gold-brick, wire-tapping, green-goods and money-machine swindles have added a permanent member to the family, and one that will take its place in regular rotation with the others. Among the other effects of the war is the addition of a brand-new trick to the repertoire of the smooth-tongued gentry. It is an unhappy confidence man who can't find a prospect to whom one of these venerable tricks is old enough to be new; but in this improbable eventuality, he now has one to fall back on that, comparatively speaking, really is new. "The world do move."

Electricity

Shock-Proof Entrance Switch.—Another recent novelty is a shock-proof entrance switch manufactured in various sizes and types, in two and three-pole, and so constructed that it can be enlarged by the use of an additional section or sections which are made to interlock with the original unit. Another feature of this device is that the construction is such that when the door is open, giving access to the fuses, the user is protected from coming in contact with any live or current-carrying parts. For apartment-house work this device eliminates meter cabinets and meter rooms.

An Automatic Switch.—Eliminating waste of current and furnishing light when and where wanted, are two of the functions of a new door switch recently introduced. This door switch provides a convenient means of control for lights in closets, telephone booths, and similar places where the door automatically snaps the switch "on" or "off." The mechanism of the new switch permits no half-way position, when the switch is "on," it is definitely on, and vice versa. Another novel switch is the bolt switch for guest rooms in hotels, which is connected in circuit with the usual wall switch. On leaving the room and locking the door the bolt switch cuts off the lights. On entering, the lights will again respond to the operation of the wall switch.

Reduction of Electrical Fires.—According to a recent compilation it appears that out of 188,553 fires which occurred in 1919, only 8,808, or 2.57 per cent, were of an electrical origin. More recent reports state that in Cambridge, Mass., in 1920 there were 780 alarms, with a total fire loss of $451,905. Only one fire was of electrical origin. In Springfield, Mass., there were 1,002 fires, with a total fire loss of $860,115, of which only three were due to electrical causes. In Carthage, Mo., there were 64 fires, only one being caused by defective wiring. It is said that 56 cities and towns have reported no fires of electrical origin during 1920. The total fire loss for these cities and towns was over $1,800,000.

French Airplane Sets.—According to a recent issue of *Radioelectricite*, all models of French airplane receiving sets employ multi-stage vacuum tubes. Two main types were in use during the war, both using a triple stage bulb and differing only in that one had a variable inductance and the other a variable condenser. Both could receive intermittent or sustained waves of from 600 meters to 1090 meters, with an aerial about 260 feet long. The plate current was supplied from a 40-volt storage battery, and the filament current from a 4-volt source. Owing to the intense cold in which the airplanes had to operate at high altitudes, it was necessary to provide some means to keep the lubricating oil from freezing and to warm the pilot's head, hands and feet. In the oil tank an 80-watt heating unit was submerged, while the pilot wore helmet, gloves and overshoes into the fabric of which a resistance wire was woven. The helmet absorbed 16 watts, the pair of gloves 36 watts, and the overshoes 29 watts. If a machine gun was carried on the plane, its oil reservoir too had a heating unit, consuming 70 watts.

Preventing a Burnt-Out Motor.—An American manufacturer of electrical controller devices has recently introduced a novel overload relay which prevents burnt-out motors. The overload relay is a thermal element placed in series with the motor circuit, and the mercury column is a part of the pilot circuit of the magnet switch coil. These relays widen the application of motors of the alternating-current squirrel-cage type because, while giving positive protection against burnt-out troubles, they insure good starting torque by permitting generous starting current for a period of several seconds. Fuse troubles and expense are eliminated; momentary overloads are allowed, but at the first sign of harmful overloading the motor is shut down. The thermal element in question is heated in the same proportion as the motor windings. Excessive current passing for too long a period heats the coil, causes the mercury to boil and the vapor to pass up into a chamber at the top of the tube. This breaks the liquid mercury column and opens the circuit of the magnet coil. As this coil is de-energized, the contact fingers drop and disconnect the motor from the line. After an interruption the thermal element cools down. The mercury becomes liquid again and drops down into the tube, forming a column through which current to the magnet will pass again after the control button is depressed. So, until the overloads reset themselves the motor cannot be started.

Science

Prof. Gabriel Lippmann, a member of the French Commission to Canada and winner of the 1908 Nobel prize for physics, died aboard the "France" on his way home from Canada.

Daylight Saving Dies in England.—Maintaining an unbroken front in opposition to daylight saving, British farmers defeated the bill that sought to make this measure permanent.

Tin Soldiers Are Neglected.—At the annual meeting of the Toy Manufacturers' Association it developed that there is little call for tin soldiers nowadays, and that mechanical playthings are taking their place

Bad Acoustics Remedied.—In Macon's new auditorium it was impossible to hear a speaker from the middle of the hall. An inner stage was erected to direct the sound toward the audience. It is said that the dropping of a pin can now be heard anywhere in the building.

A Life Income for Mme. Curie.—The women who raised the money to give Mme. Curie a gram of radium exceeded their goal by $00,000. Another fund of $50,000 is in process of collection. These funds, combined, are to provide her with an adequate laboratory equipment and a life income with which to carry on her researches.

Chateau-Thierry Re-fought.—Louis de Moulin, official war artist of France, has sent us his marvelous diorama, which avails itself of every trick of the lighting art to give us realistic vistas and amazing transformations. One scene shows a crossing of the Marne where Americans hurled back German rear guards, there are many other depictions of American bravery and success.

A Natural Fan.—A dry artesian well in Newark, N. J., has emitted a steady blast of cold dry air for 25 years. The owner, a woman, had this current piped into the house, where it keeps down the temperature in hot weather, dispels dampness, dries the family wash, and dispenses with ice in the refrigerator. The current is continuous and steady, and experts are at a loss to account for its source and action.

New York's Rural Schools.—A child welfare survey discloses the fact that New York State supports 15 one-pupil schools, 52 schools with but two pupils each, 167 with three, 892 with five, and more than 5000 schools not exceeding ten pupils each. These are all small ill equipped, inefficient. The report of the surveyors urges consolidation, with free transportation for the children, this would provide better training at less cost.

California's Lofty Mountains.—At least 60 mountains in California rise more than 13,000 feet above sea level, but they stand amid a wealth of mountain scenery so rich and varied that they are not considered sufficiently noteworthy to be named, according to the United States Geological Survey, Department of the Interior. Yet if any one of these unnamed mountain peaks were in the eastern part of the United States it would be visited annually by millions of people. But California has 70 additional mountain peaks more than 13,000 feet high that have been named, or 130 in all, as well as a dozen that rise above 14,000 feet.

Dinner-Pail Calories.—The National Research Council recently called upon fifteen leading scientists, as a committee, these men are to enlist the scientific resources of the country in the investigation of food values; hitherto sporadic movements will be coordinated, and the stenographer's lunch and the laborer's dinner pail are to be brought up to a proper calorie and vitamine content. It is purposed to devote $100,000 annually to this nutritional research, which would be of the highest importance in everyday life, to say nothing of shortage emergencies and war periods. Another problem that would come within the scope of the committee is that of utilizing for animals waste material unfit for human consumption.

Aeronautics

Between Reval and Stockholm.—The Svenska Lufttrafik has established an airplane service between Stockholm and Reval. Two trips per week each way are being made, the trip taking three hours. Mail from Sweden and passengers both ways will be carried, there being accommodations for five passengers on each trip. A subsidy for carrying mails is received from the Swedish Government, and it is expected that the Esthonian Government will also grant a subsidy to provide for carrying mail from Esthonia to Sweden.

More Light on the "ZR-2".—Commenting on the fatal ending of the "ZR 2" dirigible, the British periodical, *Flight* has the following to say: "This airship was designed to have a high ceiling—27,000 feet—and to this end her construction was kept as light as was considered consistent with adequate strength. In order to ensure lightness, several departures from standard practice were incorporated among which the employment of fewer gas bags. This would naturally result in a greater portion of the hull being affected in the case of over- or under-filling of one bag while the girder length between frames would be increased.

A New 1000-Horsepower Engine.—The tendency in aviation appears to be toward larger engines on the one hand especially for the large passenger-carrying planes and toward smaller engines for the single-seaters. Word now comes to the effect that the Engineering Division, McCook Field has completed preliminary design of a 1000-horsepower 18-cylinder engine. The design is being further developed on the basis of 1000 horsepower at 1400 r.p.m. direct drive, this speed ensuring great reliability and being favorable to high propeller efficiency in connection with a large power output. A cylinder of the proposed design has been constructed and tested with very satisfactory results. It is of the four-valve type, with welded steel jackets.

An Altitude Record.—On September 28th last Lieut. John A. Macready, test pilot at McCook Field, Dayton, Ohio, flew a La Pere biplane to a height of 41,000 feet, according to his barometer reading, but the true height after the instrument was calibrated stands at 40,800 feet, thus establishing a new world's record. The previous record was held by Capt. Schroeder who, in the same type of plane, flew to an altitude of 38,114 feet. The La Pere plane used by Macready is equipped with a supercharger recently invented by Dr. S. A. Moss, which takes care of the rarefied air at high altitudes and also takes care of changes in mixture and keeps the radiator warm. A new propeller of somewhat larger size than usual was also employed in the record-breaking flight.

Control in Circling Flight.—An investigation was undertaken by the National Advisory Committee for Aeronautics at the Langley Memorial Aeronautical Laboratory some time ago for the purpose of developing instruments that would record the forces and positions of all three controls, and to obtain data on the behavior of an airplane in turns. All the work was done on a standard rigged "JN4H". It was found that the airplane was longitudinally unstable and nose-heavy, that it was laterally unstable, probably due to too little dihedral and that it was directionally unstable, due to insufficient fin area, this last being very serious, for in case of loss of rudder control the airplane immediately whips into a spin from which there is no way of getting it out. On the other hand it was found possible to fly quite satisfactorily with the rudder locked and safely, though not so well, with the ailerons locked.

British Planes with Little Planes Upon Them.—Experiments with a remarkable type of battleplane which carries its own scout machine poised at the tip of one of its wings have been carried out at Farnborough, England. Two big bombing planes have been flying over Aldershot with a diminutive airplane fixed to the upper wing. So far it is understood that the tests have been successful. The parent machines have traveled at their usual pace although the engine of the scout machine was kept running so that it was ready to dive off at a minute's notice to protect the larger and heavier craft. The automatic releasing apparatus is constructed on ingenious lines, we learn from *Aerial Age Weekly*. An expert pilot is carried by the bombing plane and as soon as his services are required he climbs through the top wing and takes his seat in the scout plane. By pressing a trigger he frees the smaller machine which at once glides along the battleplane wing and dives off.

THIS issue marks the last appearance of the SCIENTIFIC AMERICAN as a weekly. On October 20th there will appear the November issue of the new monthly SCIENTIFIC AMERICAN, which will combine the leading characteristics of both our former weekly and monthly editions within its many pages.

Man-Made Lightning

Experiments with One-Million-Volt Transmission That Point the Way to Future Power Distribution

THE age of artificial lightning appears to be close at hand, not as a mere stage effect but as a practical means of distributing electric power over nation-wide areas. Only a few weeks back the press announced the culmination of a series of tests aiming to raise commercial currents to one-millionth volt potential and then transmit that lightning-like current over a properly insulated transmission line. The final experiments would seem to indicate that such high potentials can be generated and handled but there remains a vast amount of engineering work before we can begin to raise the potential of our electric power lines from the present high mark, 220,000 volts, to still higher potentials.

One million volts is nearly five times the highest voltage ever before placed on a transmission line. The 220,000-volt line referred to is that of the Southern California Edison Company, now in course of construction. One-million volt potential is one-fiftieth of the voltage that a flash of lightning is estimated to represent, according to Dr Charles P Steinmetz, the well known electrical engineer, so, we are slowly coming to use in our everyday life the counterpart of what has heretofore been considered a great destroyer of life and property

The remarkable high-voltage tests in which one-million-volt potential was reached took place at the high-voltage laboratory of the General Electric Company at Pittsfield, Mass. The most important point in connection with these tests is the adding of new and valuable knowledge to the long and constant study of high-voltage phenomena, upon which calculations can be based for the extension of long-distance transmission. It is also interesting to note that these experiments have been carried out by specialists in electrical transmission—men who have seen the distribution of electric current on a long distance scale begin with 15,000 volts in 1891, and culminate with the erection of the 220,000-volt line in southern California

The object of high voltages in electrical transmission is pretty generally understood today The average layman appreciates the fact that the flow of electricity through a conductor is very much like that of water through a pipe The higher the pressure or volts, the less becomes the resistance offered to the current by the conductor Hence in building a transmission line the engineer is confronted by these alternatives Either to use a heavier conductor so as to have the lowest possible resistance, in which case a lower voltage can be employed, or use a higher voltage and smaller conductor, but make ample provision for the increased insulation necessary to take care of the higher potential. Of course, conductors rapidly rise in cost for every square mil that is added to the cross section Insulation is less expensive than metal, hence higher voltages are resorted to Furthermore, since there must be a line loss in all electrical transmission, it follows that the generation of electric power at one remote spot may not be commercially practical for the reason that its transmission would involve too long a line with too great a loss, according to our present standards. But with a vast increase in potential the practical range of electrical distribution goes up by leaps and bounds, so that water power that is today considered of little or no commercial value because of its extreme remoteness may yet be used tomorrow in our workaday world.

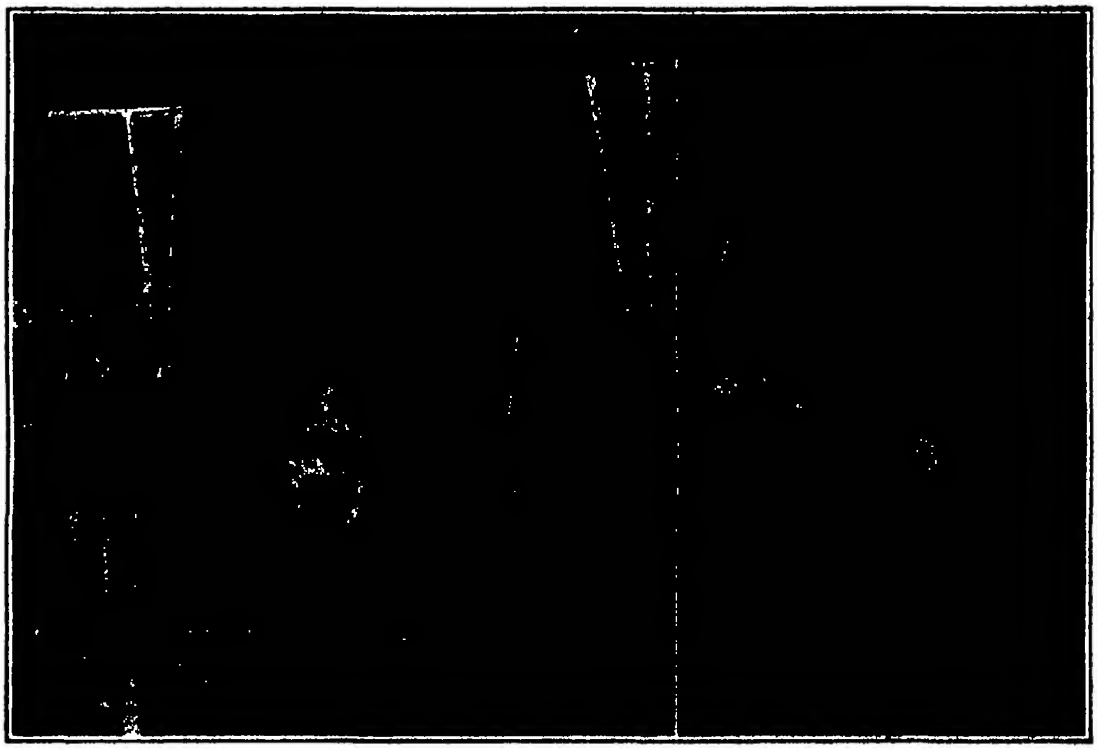
One million volts is far beyond the comprehension of the ordinary layman, states Dr Steinmetz. It is interesting to recall how rapidly high voltage development in this country has progressed. It is about forty years since Edison first transmitted electricity at constant voltage. He used 110 volts and later 220 volts. At this pressure, electricity can be sent economically for about one mile. In the intervening forty years, voltages have increased until now we are actually using 220,000 volts, a pressure just a thousand times greater than that which was considered the limit of safe pressure when Edison began his experiments.

Now we are thinking of one million volts. While electricity, as these tests show, can undoubtedly be transmitted in large bulk if so desired, for possibly thousands of miles, it is possible that the millions of horsepower available at various points, such as Niagara Falls and the St Lawrence River, would find a market and be consumed within a few hundred miles of their source

The big problem in transmitting this extreme potential is to confine the current to the wires. The loss of a part of this current through leakage into the surrounding air is an ever present possibility. This leakage takes place in the form of the corona—that effect which forms a crown of colored, luminous haze about conductors. The recent million-volt experiments have brought out the interesting fact that wires four inches or more in diameter would—and actually did—carry such high potentials without serious loss. Should we ever come to million-volt transmission, it is likely that hollow tubes would be found more economical and just as effective. It would also be found essential to build the high tension transmission lines for carrying one-million volts on high towers, in order to keep the conductors out of the reach of any danger to human life.

Aside from the transmission line proper, there are many problems in the way of transforming apparatus and switching gear. In the experiments the original or primary current was 2,000 volts at 60 cycles. This current was stepped by passing through one transformer after another—a cascade arrangement.

Our cover illustration has been prepared from an actual photograph, showing virtually a million-volt current jumping an air gap between needle points. In fact, high voltage measurements are generally taken by means of a needle gap, since there is a very definite ratio between the sparking distance between needle points and the potential employed. The illustrations on this page show the needle gap and below it the huge sphere gap, with a man standing between the sphere electrodes so as to furnish a comparison for size, as well as a flash-over test on a string insulator, using about 600,000 volts.



Left: The sphere gap used in the 1,000,000-volt tests. The needle gap employed in measuring high potentials, is shown directly above, the electrodes being held by the V-shaped supports. *Right:* Some idea of the insulation problems in connection with extreme potentials may be gathered from this view This is a high-voltage insulator test at about 600,000 volts, showing a flash-over on a string insulator and from wire to tower simultaneously, arcing distance being over six feet

Details of the million-volt transmission tests

A Fuel Comparison

By H. F. Crafts

IN approximating the intrinsic value of the farm tractor, the larger item in the account is that of superior power in action.

Among the lesser items is the economy of fuel. This may not appear so large until we strike a comparison between the cost of tractor fuel and horse fuel.

Some figures which I have recently obtained from a California farm tractor expert afford a very convenient basis for making this comparison.

The problem consists in approximating the fuel cost of 100,000 horse-power hours, as produced on one hand by the horse, and on the other by the farm tractor.

Let us take the horse side of the question first:

According to this expert, it would require 801 tons of hay and 10,625 bushels of grain to do the job.

Taking the average price of hay on the Pacific Coast at the present time to be $20 a ton, the hay item in this sum in arithmetic would amount to $6,020. Taking oats at $1.20 per bushel, the grain items would amount to $12,750, total, $18,770.

Now let us figure the tractor side of the problem

It would require 11,250 gallons of distillate and 750 gallons of oil to accomplish the 100,000 horsepower hours by the tractor

There is also a question of 125 pounds of cup-grease, but this is such a small item we will leave it out.

Distillate in Oakland today costs the consumer 14½ cents per gallon, 11,250 gallons would cost $1631.25.

Oil costs about $1.20 per gallon, 750 gallons would cost $900, total $2531.25.

Difference in favor of the farm tractor, $16,238.75.

This seems almost incredible, but it is undoubtedly true. Well, here is still another interesting phase of the question.

The hay and the grain fed to those horses could very easily be replaced by straight human food products, and if the horse were to be eliminated this food could be saved and added to the world's food supply.

This same tractor expert informs me that 40 horses will eat the produce of 200 acres of land per annum, or in the aggregate the horses of the United States require for feed the produce of 120,000,000 acres of land, or enough to support not less than 40,000,000 people.

Eliminate the horse population of the United States at a single stroke and turn the equivalent of their subsistence over for human consumption and our aggregate food supply would be increased 40 per cent.

But this is not all The farm tractor's fuel supply does not come from our soil, but from beneath it, and consists of no substance that could be possibly made available as human food. And these reflections clear the atmosphere, and permit the monumental superiority of machine power over animal power to stand out in clear and unclouded effulgence; and to reveal the magnitude of the vast burden that is destined to be lifted from the shoulders of the food-producers of the world.

Left: The disks that carry these chairs roll about at random over the floor, tipping the chairs now one way and now another, colliding and in general giving the occupants a hilariously rough time. *Center:* The cars, suspended at the end of these long arms, go around in a circle and at the same time pitch up and down as though riding the waves. The effect is highly edifying upon the passengers. *Right:* The short cars of the roller coaster, which make possible some evolutions that would have been out of the question with the usual longer cars

Some of the joy-riding stunts at the new amusement park in Venice, Cal.

Some New Mechanical Amusement Devices

THE recent announcement of a Venice, Cal., amusement promoter to the effect that his new pier would have all new pleasure devices was not taken particularly seriously until the place in question was thrown open to the public. Then, for the first time, the amusement seekers realized that he had made good his promise and that the pier housed one of the most startling collections of mechanically ingenious contrivances yet built.

While there are literally dozens of new mechanical devices for the amusement and "thrilling" of the pleasure-seekers, a description of four or five of the most ingenious will serve to give a good idea of the resourcefulness of the men who designed them.

The first concession one encounters on the new pier looks at first glance to be a number of round wicker chairs on a rough sea. As a matter of fact, the floor consists of a number of disks, eight or ten feet in diameter, each one of which revolves independently of all the others.

The chairs are mounted on an iron pivot. They are each loose. When the customers are seated in their little chairs, the disks start to revolve. As the chairs roll about, they encounter the various disks, first one going one way, then one going the other way. They bump together, bounce around, and otherwise travel in unexpected directions, while the passenger experiences a sensation similar to that of a stunt aviator.

A device known as the "Dodge-Em" is a clever piece of electrical and mechanical work. Small cars, fitted with steering wheels, are placed on a polished hardwood floor. A trolley connects each little car with an electrically-charged mesh and screening overhead. The car is mounted on casters. When all the cars are occupied, the current is turned on and the passengers endeavor to ride around the floor without colliding with other cars. As the steering wheel operates only the trolley, and as the wheels are independent of each other, the steering is only relative and it requires extreme ability to dodge the other fellow's car. A foot pedal is provided to control the car and stop it when necessary. Collisions occur every few seconds, but as there is a heavy iron bumper around the base of each car, no damage is done and the riders get lots of fun out of the thing.

The centrifugal concrete mixer

The time-honored roller coaster has been revolutionized into a thing known as the "Bobs," in which the usual cars have been replaced by a sort of series of iron baskets, mounted on wheels. These baskets are connected together into trains, but because of their independence and smallness, they operate like a bicycle chain and permit the trains to take extremely sharp turns and steep bumps with safety. Hence the "Bobs" provide thrills that the roller coaster with its long

(*Continued on page 278*)

A Centrifugal Concrete Mixer

THE open pot type of container used in preparing concrete for laboratory and commercial purposes is subject to competition if exhaustive tests now being made by the Cement Section of the National Bureau of Standards establish the merits of a new centrifugal mixer, designed by a New York City engineer. The newly-designed apparatus for mixing concrete is one-half yard capacity and consists of a horizontal bowl which is rotated about a vertical axis at 70 to 80 r. p. m.

In actual use, the contents of the bowl are thrust outward and upward by the centrifugal action, and are deflected back in streams to the center of the container by four fixed deflectors affixed to the stationary frame. To unload the mixer, the operator slightly elevates one of the deflectors, the mixture proceeding to flow over the rim of the bowl into a hopper or chute. Complete mixing of a batch of material, under favorable environments, is insured in 15 to 30 seconds.

Comparative tests conducted by the Bureau of Standards to determine the relative merits of the open-pot container and the centrifugal mixer indicate that the grinding action of the latter produces such a fine aggregate that stiffer consistencies were obtainable. The increase of fine material is such as to require from 5 to 10 per cent more water to insure the same degree of flowability as that in a similar batch subjected to the open pot or laboratory mixer.

Results of government tests show that if like batches of aggregate cement and water are mixed in the same proportions in the two types of containers, the strength of the concrete yielded by the centrifugal mixer is 20 per cent higher than that amalgamated in the open pot mixer. However, this superior strength is attained at a sacrifice of flowability, which detracts from the seeming superiority of the centrifugal mixer in comparative tests. By adjusting the water content with the view of

(*Continued on page 278*)

Left: The yacht race, in which the competing craft are driven over their enclosed courses by air pumps, manned by the contestants. *Left center:* The row of wind machines at which the yachtsmen labor. *Right center:* General view of the "Dodge-Em", the object of which is to steer the highly unmanageable car about the floor without collision. *Right:* Close-up of one of the "Dodge-Em" cars

Two more novel mechanical devices for whiling away the idle hours

The Story of Cork

Where the Raw Material for Stoppers and Floats Comes from, and How It Is Obtained

By J F Springer

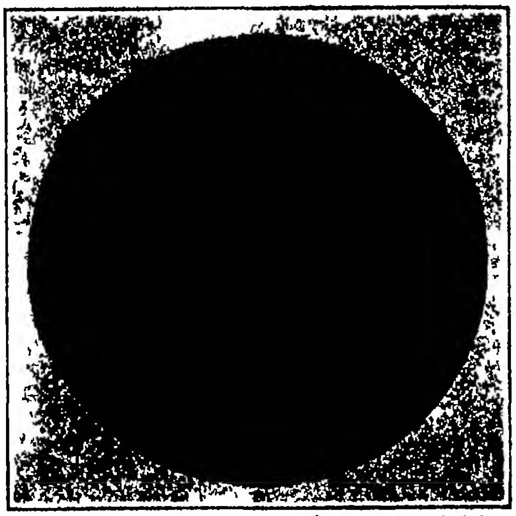
EVERYBODY knows what cork is, and is more or less acquainted with its use But comparatively few have clear ideas as to the parts of the world where it is produced and the precise way in which it grows In Portugal, Spain, southern France and generally the lands lying in and near the western Mediterranean cork is produced, on the largest scale in Portugal It is a product of a species or of two species of the oak (*quercus suber, quercus occidentalis*) Nobody seems to know the origin or the essential meaning of *suber* Some guesses have been made, but nothing substantial has been ascertained Similarly, the English word *cork* seems to be of uncertain meaning and derivation But there is perhaps a plausible connection at least with the Spanish *corcho* (cork) and the Latin *cortex* (bark) It has been suggested that it is a corruption of *quercus* However all this may be, the thing itself is definite

The cork tree grows to the height of 20 to 60 feet and the bole attains diameters up to 4 feet. But this diameter has certainly been exceeded In 1877, a tree in a cork forest in the province of Gerona in northeastern Spain measured 16 feet 3 inches in circumference This means a diameter of 5 feet 2 inches. The height up the trunk was about 15¾ feet. This tree was estimated as having at the time an age of 150 or 200 years. The foliage of the cork tree consists of small evergreen leaves, spongy and velvety to the touch The edge is of the saw-tooth type and the appearance of the leaf is glossy A representative leaf measures, say 1½ inches long by ½ inch broad The roots are robust and spreading, and are not always completely buried in the soil. The blossoms come out in May and the acorns ripen in the fall or winter The latter are of importance, since when fed to swine they are converted into a high quality of pork particularly ham Spanish mountain hams have what is called a "piquant" flavor

A notable thing about cork trees is that they are apt to require more shade for their roots than their own foliage supplies, if good harvests of cork are desired. One mode of meeting the requirements of the case is to manage the new grove so that when the trees are about twenty-five years old the branches of the trees will touch one another and the general area be fairly covered Another method proceeds by the introduction of trees of other kinds in the intervening spaces—such trees as, for example, the elm, the ash, the pine. The function of these trees is to supply shade and keep the ground rich in vegetable matter Cork trees, like milch cows, may be overfed, with somewhat similar results That is, if the ground becomes especially rich, the quality of the cork falls off. There is, however, a goodly amount With poor soil, the amount is less but the quality is good What is desired is a combination of production and high quality

The cork of commerce is the exterior shell of bark This is stripped from the trunk of the tree and sometimes from the larger branches. The young trees are left to grow in the natural way until they have reached a fair age and a moderate size Spanish law requires that the circumference be 16 inches, which corresponds to a diameter of about 5 inches The tree will then be about 20 years old The product of the first stripping is not of the best quality However the tree at once proceeds to renew the covering and produces one of a finer texture This is not removed for eight or ten years. The bark is perhaps best regarded as for the most part dead tissue The real living skin of the tree is the *phellogen*. It is the seat of growth of both tree and bark. Each year it produces two layers of cells, one for the tree and one for the outer shell In the course of the eight or ten years after the first stripping, the thickness will have become sufficiently great to warrant a second stripping This cork will be of better quality than that first produced, the texture being finer This process of stripping again after an interval of about 9 years is the customary practice, it appears, of the leading district With the third stripping at the age of say 40 years, the tree properly begins its output of high grade cork It continues productive for upward of a century An authority upon cork growing in Algeria lays down the rule that the new cork should not be stripped off until it has become 0.8 inch thick. The first cork produced by a tree (*corcho-bornio*) has but little value commercially, because of its coarseness, roughness and density The second barking (*pelas*) while not so good as subsequent yields, is sufficiently valuable to become an article of commerce.

A peculiar circumstance is the fact that the product of the larger branches is often better than that of the bole In actual practice cork is stripped from the tree at very different thicknesses, ranging, say, from ½ to 2¾ inches Naturally, the amount of cork produced by a tree will vary with the tree, its age, and the length of time the bark has been accumulating. Forty-four to 165 pounds per tree is a fair range.



The structural appearance of cork as revealed by the microscope

The stripping, as one might easily imagine, is not a matter for a careless workman nor for unsuitable tools. The bark itself must be carefully preserved in order not to lessen its value commercially The well-being of the cork tree must be cared for adequately, otherwise the source of profit may be very seriously damaged

The inner skin, that is, the true skin, must be preserved. If it is broken through at any point, there will never again be any growth at this spot. If the true skin is much damaged, the very life of the tree may be imperilled. Of course, after a stripping, this true skin will be exposed for a time For this reason, if a sirocco is raging, the trees should not be stripped, as exposure at this time might very well mean an excessive drying of the skin leading to future absence of cork.

It has been proposed to protect the true skin with

> *EVERYBODY knows what cork looks like and is more or less acquainted with its use Comparatively few have any clear idea as to the parts of the world where it is produced or the precise fashion in which it grows. That it is in a general way a wood or a wood product most of us probably realize, just what relation the crop bears to the tree from which it comes, how it is harvested, what state the harvest leaves the tree in, and similar questions, must be a dark enough secret to the majority of those who apply the corkscrew to the neck of a bottle or wrestle with unsatisfactory substitutes like the pen-knife or the skewer In this article Mr Springer gives us a comprehensive account covering all these points of puzzlement, and more besides* —THE EDITOR.

the newly removed cork. This is known as the Capgrand Mothe system. It proceeds by arranging the separated bark around the tree; but it does not seem to have been widely adopted among large producers.

The Spanish method of stripping depends upon a long-handled hatchet. Crescent shaped saws have also been employed, especially in Algeria. Whatever the tool, the workman makes two cuts all round the tree, one above and the other near the ground. The bark is cut clear through. Then these enveloping cuts are followed by one or two longitudinal ones. Advantage may be taken of natural crevices or cracks in the bark. After the vertical cuts are made, the workman, if he uses the hatchet, inserts the wedge-shaped handle and pries off the bark. Good judgment and some skill are required. The work is done in mid-summer. The exterior surface is rough and woody. This condition is due to exposure to the weather The crude raw material is boiled, whereupon the useless rough layer may be easily scraped off. The loss in weight due to this scraping operation will run up to the neighborhood of 20 per cent. The boiling procedure results in the elimination of tannic acid. The volume of the cork is increased and also the elasticity In short, after boiling, the cork is comparatively soft and pliable and may in consequence be flattened out and packed in layers.

The cork forests are likely to be in rather inaccessible situations—in the mountains and hills. It is necessary therefore to get the crop ready for transportation A rough sorting for quality and thickness is gone through with, and the various classes made up into rough bundles and put upon the backs of the burros. As the cork does not weigh much, the animal is loaded from head to tail, or nearly so, in order to provide for him a suitable load. In the principal districts, there may be a line of 30 or 40 or even 100 of such loaded burros in a single "train." They are on their way to the railway, and constitute a very appropriate means of accomplishing this first instalment of the necessary transportation, as they are competent to thread their way over narrow and precipitous paths in the mountains and hills and to pass through the alley-like streets of the intervening villages.

Once at the railway, the transportation becomes a simple, everyday affair. The destinations include seaports of Portugal and Spain. Seville, in Spain, is perhaps the principal receiver of raw cork. Here on the banks of the Guadalquivir the cork is in part manufactured and in part stored and shipped. During the latter part of the summer, the street scenes are pretty well dependent upon cork in some way. Hundreds of burros with their loads will be filling the streets as they pass on their way to this or that warehouse or factory. If the cork is to be shipped, the bales are opened up and the edges of the bark trimmed. The cork is then regraded for quality and thickness. Afterward, it is packed into bundles or bales. A usual method of packing requires that large flat pieces (planks or tables) be put at the bottom and that the smaller pieces be built up into a mass above, and that finally a second quota of big, flat fellows be put on top. The whole bundle is then compressed and bound. Steel hoops or wires serve as the binding material, just as with us in baling hay and cotton. After the baling, the cork is ready for shipment to all parts of the globe. Cork for manufacture in America is naturally received at Atlantic ports, particularly at Philadelphia, New York and Baltimore. Arrived at such ports, it may or may not require further shipment by railroad to the manufacturing plant.

There is a wonderful variety of uses to which cork is put. But the requirements of these uses vary greatly; so that it is very necessary to grade the raw product with especial reference to the precise use to which it is to be put. The raw material has already had two gradings. But these are entirely inadequate. Modern manufacturing requires sorting that will produce in the neighborhood of 150 different grades. The foreign grades number no more than about twenty-five. Some of the American gradings, for example, are exceedingly close; so close, indeed, that when made the inexpert are apt to see no difference. But success in manufacturing turns on distinguishing differences, some of them very minute.

In making corks for bottles and the like, the length of the cork corresponds with the original vertical dimension of the cork bark when still on the tree. In consequence of this condition, the thickness of the bark determines the maximum dimension of the stopper that can be made from it. The first operation upon the raw material is its subjection to a warm vapor bath. This has the effect of greatly increasing the flexibility. It also adds something to the bulk. Corkwood is hard to cut, as the reader, if skeptical, may determine very readily by actual trial with a penknife. To [illegible]

and elasticity create difficulty. At the big factory, the cutting of the layers into transverse strips is done by a rapidly rotating steel knife of circular form. It has an edge like a razor and succeeds where a more slowly moving knife would fail. The strips are then operated on by a tubular punch rotating like a machine twist drill. This work is done with the greatest rapidity The stoppers as they come from this operation are cylindrical. If tapered corks are wanted a supplementary operation is carried out with another rapidly rotating circular knife. But the foregoing accounts for only some of the corks. Many stoppers are made along the lines of the old Spanish method. That is, after the strips have been cut and the outer rough crust has been taken off, the strips are cut into box-like pieces—parallelopipeds. From these rectangular blocks the stoppers are fashioned. Often this fashioning is done by hand methods. The making of stoppers is very wasteful, so much so that only about 35 per cent of the original weight of raw corkwood remains in the finished article. Hence the efforts to use the 65 per cent. Composition cork is made from waste with the aid of proper binding substance. This composite material then becomes basic for a whole line of manufactured products—table mats, fishing line floats, polishing wheels, etc. A special material for heat insulation is also made from the waste—that is, in this case, from granulated material.

1. A cork tree, showing the typical low trunk and free-spreading branches 2. A corner of a sorting room in the cork warehouses of Seville 3. Preparing the cork for carriage to the railroad

Before and after the cork harvest

The U. S. Collection of Animal Parasites

By S. R. Winters

IF the Bureau of Animal Industry of the United States Department of Agriculture were abolished—a far-fetched supposition, to be sure—its laboratory collection of specimens of parasites which infest domestic live stock would automatically become the property of the National Museum. So valuable and comprehensive is this cumulative knowledge relating to pests which prey upon horses, cattle, sheep, swine, poultry and other animals, probably the biggest collection of parasites in the world, that specific Congressional legislation safeguards this massed information for posterity

The assembling of parasites, which work was initiated by Dr. Cooper Curtice in the late eighties, and formerly arranged into logical groupings by Dr C. W. Stiles and Dr. A. Hassell, has attained such enormous proportions that in excess of 10,000 ledger pages have been utilized for entries. Two books, embodying 5000 accessions each, have been filled with notations on individual or groups of parasites, and the third ledger account is being written. The specimens, upon being consigned to the Zoological Division of the Bureau of Animal Industry, are bottled in a preserving fluid and the label reflecting the contents is encased inside of the container to avoid blurring or effacement The data incorporated in the big daybooks of the laboratory include the technical name of the worm or parasitic insect, date of collection, by whom collected, and the location of the specimen when taken from its host

The flukes, tapeworms, roundworms, parasitic insects, ticks and mites are predominant in the world's largest collection of live stock enemies. The bulk of the vast assembly of parasites were formerly unbidden guests of man, horse, mule, donkey, cow, sheep, goat, swine, dog, cat and poultry The Zoological Park of Washington, D C., is likewise a contributor to the collection, wild animals yielding a varied assortment of preying insects. Foreign countries make consignments of their undesirable guests, soliciting the Department of Agriculture to identify these parasites and prescribe control methods. The investigations primarily, however, concern themselves with enemies of the live stock of American farmers, the massed knowledge lending itself readily to application afield wherever parasites infest domestic animals.

Augmenting the 10,000 bottled specimens of animal parasites is the largest card catalogue and index system ever corraled on the subject. It is a monument to the efforts of Dr A Hassell and his associates for an unbroken period of 30 years. From 1902 to 1912 there was published 2766 pages of authors' catalogue, and the unpublished material which has since accumulated will swell the pages of this volume The information on the tapeworm extends through a book of 467 pages, printed in 1912. A catalogue compiled by C. W Stiles and A Hassell during 1920 consumes 886 pages, while knowledge relating to flukes embrace 401 pages, appearing in book form in 1908.

Quite logically, the American live stock grower and farmer inquires as to the serviceableness of this profound knowledge when bound between the lids of a book, which has quarters in a laboratory in Washington, D C The Zoological Division of the Bureau of Animal Industry would answer in this wise What has been done the world over in eradicating parasites from domestic animals has been assembled in compact form, the information being quickly available to farmers, veterinarians, physicians and scientists. The knowledge can be speedily given practical application Take a glance into the mail of the Zoological Division and note the variety of inquiries which draft upon this fund of information!

The United States Army submits a consignment of smoked herrings infested with roundworms a citizen of North Dakota desires pictures of parasites to illustrate a book, a farmer in Florida seeks a remedy to expel kidney worms from swine a resident of Pennsylvania submits a group of lung worms from sheep for examination, a rural dweller in Illinois consigns to the laboratory for analysis some earth worms found in the drinking water, a commercial enterprise in Maryland solicits expert advice concerning a louse powder, an officer in Texas sends to the Zoological Division a collection of ticks from a goat a meat inspection service submits for inspection a ham infested with mites, with the view of eliciting information as to control methods, a veterinarian in Texas invites discussion of a tapeworm from a goat, a commercial concern solicits information on dips.

The development of a new theory concerning the distribution of the tapeworm among poultry, the recommendation of gasoline in treating wounds infested by screw worms, experiments looking to the rearing of lambs to marketable age without loss from stomach worms, and the minimizing of losses from roundworms among young pigs, comprise recent contributions of the Zoological Division to the study of parasites. Field investigations in McLean County, Illinois, include observations of 3500 pigs on 20 farms where losses from roundworms are being reduced The method employed is Prior to farrowing time, loose litter is removed from the farrowing pens, the latter being given a scrubbing with boiling water and lye Ten days before the sows are expected to farrow, their udders are cleaned and the sows placed in clean pens. Soon after farrowing the sows and pigs are given quarters in a clean pasture. Some portable sheds or houses, which follow the succulent pasturage, afford shelters for the sows and their offspring The losses from roundworms when this method is followed are almost negligible

Saving Uncle Sam's Pennies

The United States Bureau of Efficiency, and What It Is Doing to Conserve Federal Funds

By Herbert D. Brown, Chief of the Bureau

Abstracted from a paper read before the National Association of Manufacturers on September 18th, 1921

THERE have been efforts in the past to investigate the conduct of the business of our Government, but none of them have amounted to much save in the accumulation of data of value. The present Bureau of Efficiency began on March 4, 1913, as a division in the Civil Service Commission with an appropriation of $12,000 for the first year. It became an independent establishment on February 28, 1916, and this year it has an appropriation of $125,000. It is the only office of the Government created for the exclusive purpose of saving money, all others are engaged in spending it.

I had the honor of being connected with two previous commissions of similar character. Having observed the efforts of these organizations to improve the departmental service, and having studied the reports prepared by the gifted men who were members of these organizations or employed by them, I came to the conclusion that they had fallen short of rendering the great services which might have been expected of them, because they had not perceived that only by personal investigation of the offices themselves, by tact and patience in dealing with the workers of those offices, and by absolute willingness to surrender all credit for their services, could their ends be attained. I believe that only by winning the good will and cooperation of the administrators and the employes in the offices in which the work is done is it possible to achieve permanent results.

First of all, the watchword of the work must be "cooperation, not coercion." No officer of the Government is happy to have an outsider come into his office and assume to dictate how many clerks he should have, and what he should pay them, and how they should do their work.

Secondly, as a part of the general policy of cooperation it was necessary to adopt the principle of "no publicity." It is dangerous to the success of our work even to make detailed reports about it to Congress, if there are to be published. A bureau chief is not likely to be much more amiable if the delinquencies of his office are described in an annual report than if they are described in a daily paper. It has, however, been no part of our policy to conceal our operations. Although our published reports are meager, there is no lack of typewritten reports in our office which contain full and detailed accounts of every change and recommendation for which the Bureau is responsible.

The third principle guiding the Bureau in its work is that it acts in an advisory rather than a supervisory capacity.

The fourth principle that seemed to me from the first fundamental in efficiency work was the substitution of what might be called laboratory tests for academic discussions. There has never been time nor inclination in the Bureau of Efficiency to write lengthy reports, but there is always time for careful experiments and prolonged tests of proposed operations. Our general practice has been to take a representative part of the work to our own office and experiment with it until we have devised what we believe to be better or more economical methods than those employed.

The next principle that I felt was important was that emphasis on "team work" might develop an esprit de corps in the Bureau that would offset in some measure the small salaries paid by the Government for this kind of work compared with the salaries paid by private firms.

Finally, as a sixth principle, it was clear to me that the Bureau must be absolutely and under all circumstances non-partisan. To an efficiency organization it should be a matter of indifference what party is in power. Good government should be the only interest.

Generally speaking, our Bureau does two classes of work. First, we handle problems specifically assigned to us by Congress, either by statute, by resolution of either House of Congress, or more or less informally by the various committees and individual members of Congress. Second, we assist heads of departments and bureaus in developing better methods and procedures for doing their work.

Congress has, from time to time, given us a wide variety of things to do. As a result of our recommendations, legislation was enacted at the last session of Congress abolishing the Subtreasuries. This recommendation alone resulted in saving nearly half a million dollars a year in administrative expenses and about $2,000,000 a year in interest on the Public Debt. We have installed a system of efficiency ratings for the employes in the Post Office Department. We are engaged at this time on a similar installation for several offices of the Treasury Department. We have made actuarial valuations of the cost of the various pension plans which from time to time were proposed for retiring superannuated employes. We have installed an accounting system in the Indian Service. For about three years we cooperated with the Bureau of Internal Revenue in solving the immense problems which confronted that Bureau in collecting the income and excess profits and other taxes. We submitted reports to the Budget Committee of Congress which had a material influence on the budgetary legislation which was adopted at the last session. We have concluded an investigation of the methods of the Civil Service Commission. We have about concluded our investigation of the statistical work of the Government. We shall submit proposals to Congress when it convenes in December for the reorganization of the executive branch of the Government needed to eliminate the duplications of work and overlappings of authority which now characterize the activities of many of the executive departments. This, in a general way, will give an idea of the kind of work which the Bureau of Efficiency has done and is now doing at the direct request of Congress.

BEFORE the United States went to war with Germany, the contribution of its average citizen to the maintenance of the general government was small, and was collected from him indirectly so that he scarcely realized that he was required to make the contribution. It followed that his interest in the operations of the Federal Government was languid. The war has changed all that. For the first time in his life the citizen has had to give and lend directly to the Government from his private store. The Government has slowly demobilized its fighting forces and still more slowly relinquished its control of problems of production, supply, transportation, and finance. But the heavy cost of government continues and the people are naturally asking why. They are wondering whether the heavy taxation is the result of wasteful mismanagement in the Government offices. Mr Brown's bureau is answering this question, and we are glad to let Mr. Brown tell the story to our readers.—THE EDITOR.

The work which we do, however, at the request of heads of departments and bureaus is fully as important as that which we do at the request of Congress. The Bureau has worked in six departments and six independent establishments and up to this time has prepared and submitted about 70 separate reports. We have made 224 investigations, which we classify as follows: Office methods, 38, filing, indexing, 28; labor-saving devices, 17, cash accounting, 17, property accounting, 8, securities accounting, 1, cost accounting, 1, pay system, 5, auditing methods, 11, duplication of activities, 9, organization, 18, statistical, 10; actuarial, 3, employment methods, 2, efficiency ratings, pay standardization, 26; work records, 5, special investigations, 30.

I am pleased to record that most of the recommendations made in these reports have actually been adopted. I believe that our success is due largely to our adherence to the six principles noted above and adopted at the beginning of our work as fundamental.

While concentrating upon specific problems in the offices which it was directed or invited to enter, the Bureau of Efficiency has been working steadily at the larger problem of improving the administration of the Government as a whole.

The quality of administration in the Government service, as in any private business, must depend upon two factors: first, the character of the personnel employed and, second, the details of organization under which the personnel is required to do its work.

The personnel troubles of the executive departments are generally due to two conditions peculiar to Government employment. In the first place, the important administrative positions in the service are filled, ordinarily, by persons who make no claim to administrative or executive ability, persons selected primarily on grounds of political expediency, and, in the second place, the salaries of the technical and supervisory officials and employes are woefully inadequate. The second of these conditions, fortunately, is by far the more important as a factor contributing to inefficiency. I say fortunately because it is possible to correct that condition, whereas, so long as we maintain a party form of government, politics will continue to dictate the appointment of the few major executive officials of the Government. This is in fact desirable in order to avoid the possible development of a hard and fast, though of course highly efficient, bureaucracy not responsive to the will of the people.

The Bureau has made a study of salaries paid by State and municipal Governments and private establishments that will enable Congress to readjust salaries in the Government service on a scientific basis. Congress alone has power to act in this matter, and Congress is ready to act, I believe, provided it has honest, unbiased, complete and accurate information upon which to base its action. This information will be available in December, and I hope it will result in legislation which will make it possible for the Government to obtain and hold competent and efficient workers in those positions that carry the great burden of the Government service.

The second factor which contributes to the present ineffectiveness of the Government as a business establishment is found in the improper organization of the executive branch of the Government for effective service. We are all familiar, at least in a general way, with the defects of the present administrative machinery. We know, for example, that the Interior Department now has jurisdiction over a great number of bureaus of a miscellaneous character that have nothing to do with each other or with the functions which the Interior Department was originally established to perform. We know that many agencies have been located in the Treasury Department, the great fiscal department of the Government, which are purely non-fiscal in character, such as the Coast Guard, the Public Health Service, the Supervising Architect's Office, and the Bureau of War Risk Insurance. We know that the great bulk of the civil public works of the Government are executed under the supervision of the War Department, although the Bureau of Public Roads is located in the Department of Agriculture and the Reclamation Service in the Department of the Interior. We know, furthermore, of the independent existence outside the jurisdiction of any of the great executive departments, of some forty-odd boards, commissions, offices and bureaus which, practically speaking, do their work without any supervision whatsoever. These are merely examples of a condition that would require volumes to describe fully, but is generally understood.

This also is a condition which the departments themselves are practically without power to remedy. The present details of organization have been prescribed by Congress, and only Congress can take action to effect a proper alinement of the agencies of the Government and a proper distribution of work among those agencies. On this matter also Congress is, I believe, ready to act, and here again the Bureau of Efficiency has been asked to aid in the collection of the information upon which intelligent action can be taken. We shall submit in December a plan for the regrouping of services according to the nature of the work performed. Our theory is that all services operating in the same field should by law be placed under one general executive direction, and that, conversely, the field of action of each executive department should, so far as possible, be restricted to a single class of closely related activities. As an illustration of the application of this theory, all the great public works establishments of the Government, including river and harbor work, the construction and maintenance of public buildings and grounds, the Reclamation Service, the construction and maintenance of public roads, the development of inland waterways and

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Blast Furnace Slag

What It Is, and How It May Be Used as a Building Material

By Richard Gruen*

BLAST furnace slag is a product of the blast furnace in the manufacture of iron and is formed by the chemical combination of the gange material or the earthy constituents of the iron ore and the limestone or dolomite flux added to the furnace charge. It floats on top of the molten iron in the lower part of the furnace and protects the same from being re-oxidised by the hot air blast that blows through the furnace. When the furnace is tapped, the molten iron and slag are separated, the slag flowing in one direction into large ladles on flat cars, while the iron is permitted to flow into pig iron molds. The hot slag is dumped out of the ladles at a suitable part of the plant and allowed to cool in a pile. Then it is either processed in some way or else used or sold as such to fill in ground.

A distinction is made between two kinds of slag, acid slag which can be drawn out into a string just like honey when it is molten, and basic slag, which does not possess such a degree of internal cohesion, but which breaks off short when drawn out in this manner. The first kind of slag contains much silica while the latter kind contains considerable lime.

The slag that is dumped out of the ladles in the hot state and allowed to cool off on the ground has an appearance much like that of the volcanic rock basalt and is called lump slag. Many slags of this nature, in which the individual pieces are not large, crumble away to a fine dust after several hours' or weeks' exposure to the air, due to the crystallisation processes which take place within the lumps.

If there is a plentiful supply of water, then the slag can be run into a large vessel containing a great excess of water and the slag sand which is obtained in this way can be sifted to remove the large particles. The conversion of the slag into furnace sand is called granulation.

Slag is a lime alumina silicate, in which the proportions of lime, alumina and silica vary according to the iron ore that is smelted. There is a little magnesia present as well, and when spiegel iron is made, the slag contains manganese.

Each individual slag has its particular uses, dependent on its properties which are a function of its chemical composition. For example, the slags which contain large amounts of manganese and which were originally thrown away are now used in the manufacture of ferro-manganese. Many slags are suitable for the making of glass. Only a small amount of alkali and silica need be added. It is strange to say that in spite of the ease with which this can be done there is no mention made of the same in the literature and it has not come to the writer's knowledge that any glass plant has used slag for this purpose. Slag has also been used in mining work, especially in coal mining, to fill up the cavities made in the earth after the coal has been removed. Lump slag and slag sand have both been used for this purpose, being mixed with water in regular cement mixers on the spot. The granulated slag gives the better results.

At the present time, slag is being used more and more as a construction material in building houses and other structures. Sand slag has been used with considerable success in road making. It forms a hard, firm surface due to the property that it has of hardening in the air.

Lump slag has been used for some time in the past in the manufacture of paving stones. These stones are roughly formed from cast slag blocks that are cooled very gradually, whereby the slag is given a tempering action, and is then not so apt to crack. The difficult part is to separate that slag which has a tendency to fall to pieces on exposure to air. A mere chemical analysis does not afford sufficient information to tell which slags are subject to this action, and neither does a microscopical examination yield the necessary information. It has been proven by experience that the surest way in which to tell which slags are unsuited for making paving stones, because of their tendency to fall to pieces on exposure to the air is to have the expert blast operator examine the slag and abide by his decision. He can tell from its external appearance whether or not the slag possesses the proper stability to be used for this purpose.

Blast furnace slag is an hydraulic cement that is, it becomes hard and stone-like from the interior outward in air and under water. This fact has been known for a long time. The reason for this property can be seen readily from an examination of the composition of blast furnace slag and that of ordinary portland cement. The former contains the same oxides in composition in about the same proportions as they are found in cement. Therefore it is not strange that it exhibits the same properties.

In spite of the fact that this knowledge has been common property for quite a long time, the use of slag on a large scale for this purpose has not had a very rapid development. The scientific principles underlying its use have been evolved very slowly due to the difficulties encountered in investigation work of this nature and as a result thereof, the use of slag in the manufacture of cement was retarded considerably. The first experiments were made in an attempt to make a cement by adding lime to molten slag and mixing the two together. This was naturally unsuccessful, as it did not take into consideration the fact that in the making of cement the raw materials had to be heated to a high temperature. When this sort of experimentation was abandoned and the slag was cooled and then ground up, it was found that the ground slag, which gave a good cement today, refused to set the next day. Patient experimentation revealed the fact that the reason for this phenomenon lay in the physical condition of the slag, and it was found

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*Zeitschrift f. angew. Chem., 1921, 101-103

Our Latest Science—Eugenics

Its More Important Findings and Its Bearing Upon the Future of the Race

By Albert A. Hopkins

A NEW science seems almost impossible, yet it is brought home to us that the science of eugenics as developed by Darwin, and more especially by Sir Francis Galton, has come to stay and take its place with the more exact sciences. A message of hope has been brought to this country by the delegates to the Second International Congress of Eugenics which has just been held in New York in the "Hall of Man" at the American Museum of Natural History. Major Leonard Darwin, the illustrious son of an illustrious father and near kinsman of Sir Francis Galton, made the initial speech. He emphasized the impossibility of attempting to regulate human mating by legislation and deplored the popular misconception of eugenics which credited that science with a design to abolish romance, and to introduce "cattle-breeding" principles into the domestic affairs of human families. On the other hand, love marriages were extolled as natural eugenics. Marriages for money and other advantages were denounced as "dysgenic," which means as tending to the deterioration of the race, instead of the improvement.

The tracing of heredity backward from son to father, with the help of the knowledge of eugenics, was discussed by Dr. Charles B. Davenport, who said:

"Our knowledge of the inheritance of physical traits is sufficiently precise to be applied practically to cases of doubtful parentage. If the child, the known mother and both of the putative fathers can be seen and some inquiry be made as to family stock of the three adults, a decision can generally be rendered with a high degree of certainty, ranging from 75 to 90 per cent. For, usually, there will be not one critical trait merely, but several traits, whose combined evidence will be overwhelming. Already the Eugenics Record Office has been asked to answer certain questions about the inheritance of traits in a case of a claimant who maintained that he was the son of a wealthy man who died without known heirs. As lawyers get used to the idea, eugenical knowledge will be more and more called upon."

The romances which eugenics has already actually blighted or fostered in cases in which intended unions were submitted to the analysis of eugenic experts at Cold Spring Harbor, were discussed as follows: "There will come a realization of the importance of heredity in marriage matings. Young persons to whom marriage is so serious a matter will be led to stop and consider when they feel they are falling in love, and inquire concerning consequences to offspring. Already there is being developed a well-defined conscience in the matters of cousin marriages and of matings into families with grossly defective members."

All the speakers took rather pessimistic views of the future of the human race because of the threat of race degeneration in the breeding out of the best stocks and the rapid increase of the poorer strains. The "melting pot" theory is a complete fallacy, according to eugenics, because it suggests that impurities and baser qualities are eliminated by the intermingling of races, whereas they are as likely to be increased. The various speakers who dwelt on the subject were all on one side, holding that the mixture of poor stock with a good one does as much harm to the good stock as it does benefit to the poor. The theory held by some eminent anthropologists that all races have an equal capacity for development and that all race questions, even the negro question, are to be solved in the long run by race mixture, was vigorously combatted. Denying that certain race stocks are poor because of poor environment in the old world, the eugenists averred that education and better economic conditions in this country could only imperfectly overcome ingrained racial and family defects.

One of the strongest talks on the subject was by Professor Henry Fairfield Osborn, President of the Congress. "In the United States," he said, "we are slowly awaking to the consciousness that education and environment do not fundamentally alter racial values. We are engaged in a serious struggle to maintain our historic republican institutions through barring the entrance of those who are unfit to share the duties and responsibilities of our well founded Government. The true spirit of American democracy, that all men are born with equal rights and duties, has been confused with the political sophistry that all men are born with equal character and ability to govern themselves and others."

Professor Osborn said that 500,000 years of evolution had impressed certain characteristics on the three great racial branches—the Caucasian, the Mongolian and the Negroid, and their variations. He said there was no form of matter so stable as the germ plasm on which heredity depends, and that this accounted for the stubborn permanence to types and of the survival of their original qualities in admixtures.

"In the matter of racial virtues," he said, "my opinion is that from biological principles there is little promise in the melting pot theory. Put three races together, and you are as likely to unite the vices of all three as the virtues.

"For the world's work, however," he said, "give me a pure-blooded negro, a pure-blooded Mongol, a pure-blooded Slav, a pure-blooded Nordic and ascertain through observation and experiment what each race is best fitted to accomplish in the world's economy."

The closing decades of the nineteenth century and the opening decades of the twentieth have witnessed what may be called a rampant individualism—not only in art and literature, but in all our social institutions—an individualism which threatens the very existence of the family, this is the motto of individualism, let each individual enjoy his own rights and privileges—for tomorrow the race dies. In New England a century has witnessed the passage of a many-child family to a one-child family. The purest New England stock is not

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Some of the things that make aviation safer than it was. *The instrument in the middle, that carries no signboard, is a compass*

The Aviator's Tell-Tales

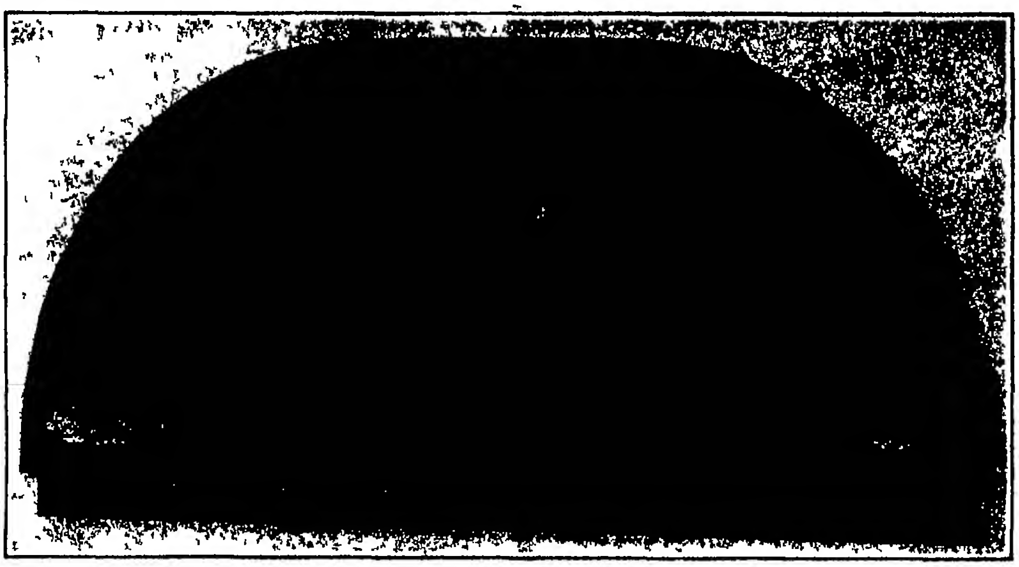
How the Pilot Keeps Track of Distances and Speeds, and Stays in the Air On an Even Keel

By William R. Andrews

IN marveling at the performances of daring aviators how many people realize that the achievements of these men would be impossible without the dependable *pilotage instruments which represent the labor of in*ventive genius covering long periods of field experiment and laboratory research?

A number of factors enter simultaneously into the guidance of an airplane. The aviator must always bear in mind many things at once. He wants to know how high he is flying. But at the same time he naturally needs to know how fast he is going. And in maintaining speed how is the airplane performing? Is it moving through space inclined to the right or the left like a ship that rolls over to one side in a heavy sea? Is the plane keeping its set course? Is each propeller running at the same speed as its neighbor? The fuel tank demands a vigilant eye, how long will the gasoline last at the present rate of consumption? Close observation of the temperature of the whole power plant is also necessary. Of course on every journey there must be an accurate timepiece. Furthermore, if the aviator intends to make a great ascent there is the oxygen apparatus, with its vital indicator upon whose precision so much depends.

The altimeter and the air-speed indicator would probably be the first of the instruments to catch the attention of the average man gazing for the first time at the instrument board of an airplane cockpit. The *importance of the others as an essential part of the* complete equipment would be temporarily lost sight of. The dullest imagination could not fail to respond to the significance of the self-explanatory words altimeter and air-speed indicator lettered prominently on the face of the instruments. In addition to their practical service they symbolize the romantic aspect of aviation—man's final entrance into the penetralia of great heights and his ability *to fly through the air faster* than the swiftest bird.

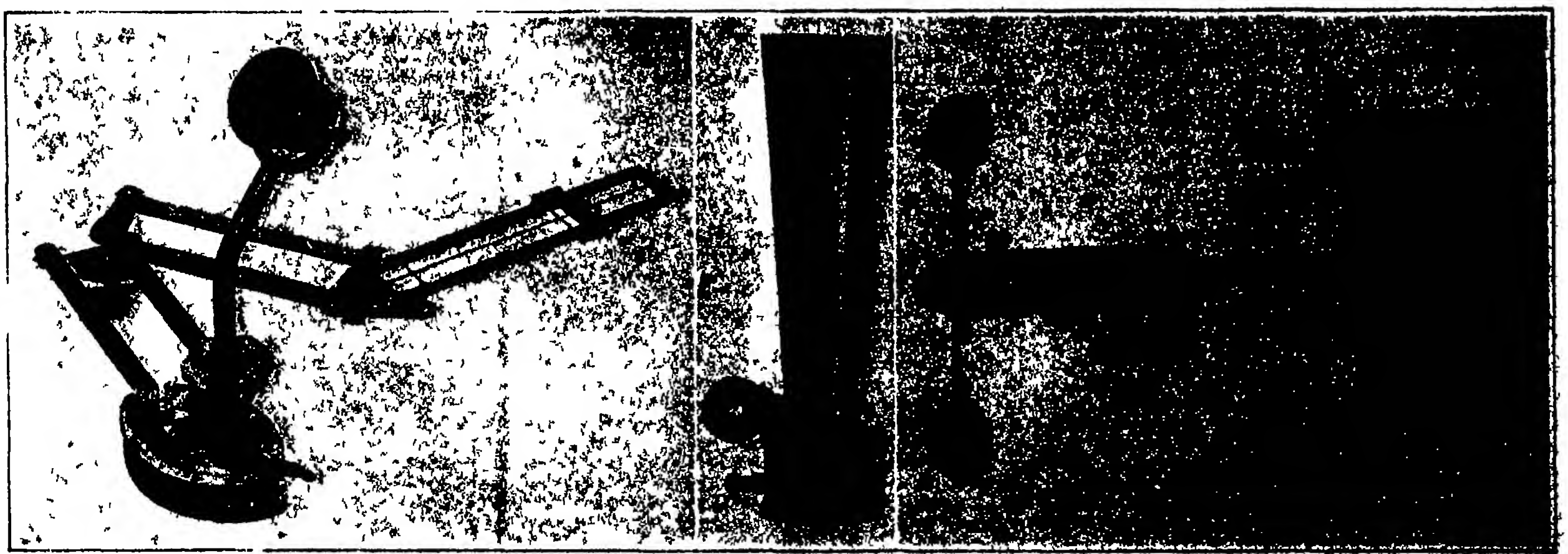


On this instrument board are shown the instruments in most general aeronautical use: Altimeter, clock, air-speed indicator, compass, tachometer, pressure gages and radiator thermometer

The preponderance of dials and the absence of switches and levers indicates that this instrument board belongs in an airplane, not in an automobile

The first of these outstanding instruments, the altimeter, is fundamentally an aneroid barometer. But in the operation of the mechanism the registration of barometric pressure is changed into a dial indication of feet, yards or meters above sea level. Altimeters must be made with exactness, otherwise the vibration of a plane will joggle the pointer beyond all hope of anything like an accurate reading. The corrugated metal vacuum chamber governing the movement of the pointer must necessarily be very sensitive to variations in atmospheric pressure, for the tip of the pointer must move one inch on the dial when the box, from which the air has been removed, expands even so slightly as 0.002 or 0.003 of an inch.

An altimeter is called a barograph when it records the gradations of ascent in a permanent form. On this type of instrument is a revolving drum to which a chart is attached and a pen describes certain curves corresponding to the altitude. Only a special kind of ink, which dries slowly, can be used, and the drum



Left: The device that indicates drift and ground-speed. *Center:* The venturi tube that helps to measure the great air-speed. *Right:* The aviator's [illegible], that [illegible] the number of air-miles covered

More intimate views of the instruments upon which the aviator's course depends

[illegible] work. As the barograph would get [illegible] the heavy jolting inseparable from the [illegible] landing of an airplane, the instrument [illegible] in the cockpit by elastic cords. These [illegible] and prevent any disarrangement of the [illegible] mechanism or any premature chart [illegible] pen. The barograph is used in place of the altimeter only in test flights for the purpose of making official height records.

The instrument used to determine the speed of an airplane consists of two parts—the indicator proper and a pressure head, generally a kind of tube arrangement, which will be described later. The indicator is fixed on the dashboard and its function is the measurement of the differential pressure caused by the air rushing through the tube, which, in turn, is mounted to a strut, or wing brace. This pressure head usually consists of a combination of a pitot and a venturi tube. The first consists of two concentric pieces of tubing, with one end set squarely upstream to the air flow. A series of very small holes runs the length of the inside tubing. The space between the two concentrics is sealed at the end of the tube so that when the air enters the wind finds access only through the perforations of the inner concentric. This arrangement produces a suction effect on the outer tube and pressure on the one inside. The difference in pressure is then measured by a gage and the result is shown on the indicator in the cockpit. In some makes of air-speed indicators only the pitot tube is used.

The venturi tube, now so generally combined with the pitot, as mentioned above, is short, flares out at both ends and is constricted between the two openings. The pitot tube, long and narrow, on the other hand, has no variation in its diameter. An idea of the shape of the venturi becomes obvious by comparing it with an old-fashion blunderbuss, the kind that one associates with Stevenson's romances. A side tube meets the main tube at right angles at the point where the "blunderbuss" tube is the narrowest. Air passing through produces a suction effect in this side tube. As the velocity is greater at the constricted part of the main tube than at its mouth, there is considerable increase in the suction effect—in which consists the advantage of the venturi tube. The air-speed indicator is a stability instrument. By its aid the aviator is able to avoid the loss of flying speed and to keep on the safe side of excessive speed. The true speed is not shown and the aviator is obliged to make certain calculations to determine the distance being covered.

There is another instrument, however, which relieves him of this necessity and shows at a glance the number of miles traveled—the air distance recorder. On this the reading is simplified, as in the case of a pedometer used by a pedestrian or a distance indicator on an automobile. The distance indicator is operated by a rotating vane attached to a brace or wing support.

The venturi tube is used in another airplane instrument, the gyroscopic form of turn indicator, which shows any deviation from a straight line course. The air passing through the venturi tube furnishes the power for the operation of a small gyro, which spins about a lateral axis at about 7000 revolutions a minute. The well-known law of gyroscopic precession governs the operation of this type of turn indicator. When a gyroscope is affected by any motion, except motion on its own axis, it moves at right angles to the applied motion instead of in the direction of the applied motion. Bearing in mind this principle, one readily understands how the indicator works. As an airplane turns to the right or to the left the motion generated sets up a state of precession which, more intense than the motion caused by the veering of the airplane, is registered by the instrument dial. For the guidance of the aviator a white-mark appears and he turns the rudder on that side to regulate his course.

The operation of the other type of turn indicator is based on the measurement of differential pressure. In this connection a static head is fixed to each wing tip. This type, however, has disadvantages. Should the airplane strike a wide area of atmosphere also in a state of rotation, the instrument might read zero. But in the case of the gyroscopic types the absolute rotation is shown, and it measures the actual rate of turn.

Then there is the inclinometer, sometimes incorrectly called a banking indicator, which has a distinct function of its own. The tilt of an airplane, fore and aft, is shown by the inclinometer. There are two kinds. One is gyroscopic in principle, but the most common type consists of tubes filled with liquid and made to form a closed triangular circuit. The contents of the tube seek its level when the plane makes an upward climb. A scale shows the aviator the change in position [illegible] by the meniscus, the curved surface of the liquid column. This instrument is used only in test flights.

Banking indicators show how much an airplane rolls over on either side. There are also two kinds of these instruments. In the type which finds greater favor the familiar spirit level is modified to suit flight requirements. The other style operates by a pendulum, which is attached to a metal cross-piece on the face of the indicator.

In the upper part of some instruments white lines are to be seen which represent in the rough a transverse section of an airplane. When the machine turns on its side so that the right or the left wing tilts down—or "banks"—the pendulum actuates the metal bar, which forms an angle of greater or less degree with the small plane on the dial. The pilot knows that this condition of overbanking or underbanking has been corrected when by manipulation of the controls the metal bar and the miniature plane on the indicator become parallel. In another kind a white spot appearing at the crucial moment performs the function of the miniature indicating plane.

Connected with the vital part of an airplane, the motor, is the tachometer, which indicates the number of revolutions per minute of the propeller shaft. Thus correct engine speed may be obtained, which is particularly important when a plane is driven by more than one motor, as is now generally the case. Unlike some of the other instruments on an airplane the tachometer is not a device specially designed to meet certain conditions in aviation. The aircraft tachometer is merely an adaptation of an instrument—operating on the centrifugal principle—which, for instance, has been in use for some time on twin screw steamships for the maintenance of the same speed in both propellers.

While the centrifugal type is the most common in aviation, others have been tried out for airplanes. One kind has a clock work mechanism and counts the number of revolutions of the propeller shafts in a given interval of time. It is too sensitive to shocks, however, for practical use. In the case of those tried out during the war it was found that vibration from the big guns disarranged the delicate adjustment of parts necessary in the chronometric type. In the liquid type the angular acceleration—that is, the speeding up or slowing down rate of the propeller shaft—is indicated by a comparison of the fluctuations of two liquid columns in connection with a Bourdon gage. Other types are the elastic, the air pump, the magnetic and the air-viscosity, the latter being like a torsion viscosimeter, which records the rate of rotation of a fluid—in this case, air, as its viscosity is almost a constant, the change made by the dial is practically in proportion to the rate of rotation.

In the rate-of-climb indicator—used only in connection with laboratory and experimental work—the upward speed in feet per second is obtained by direct reading. A manometer—an instrument which measures the elastic pressure of gases and vapors—is part of this particular indicator.

An instrument for seaplanes skirting close to the surface of rivers and the sea is the night altitude indicator, optical in principle and built on the range finder plan. However, it is not in general use.

The side slip—a lateral movement of a plane caused by overbanking or by underbanking—is measured by the yaw indicator. Again the principle of operation is that of differential pressure. This is another instrument used only in experimental work.

Both the magnetic and the gyroscopic compass have been adapted to airplane use and at one time the long-period magnetic was used by many aviators as it performed the function of a turn indicator. In the gyroscopic form the actual turning rate is measured. For overcoming the constant vibration of a soaring plane a jeweled spring pivot of an adjustable nature and studs of rubber are used.

Then there are a number of thermometers and gages which show the condition of the various parts of the motive unit—the gasoline tank system of lubrication and the radiator. As to the thermometers the type is that which depends upon the vapor pressure of a liquid in a bulb. Although they cannot be seen directly because of their location, the results of their operation are placed under the eyes of the observer in the cockpit by the aid of a long distance Bourdon tube system.

In a general sense indicators for the gasoline tank may be classified as depth gages and flow meters. The former are constructed to indicate the contents-level by either a float like that in a domestic water flushing box, or by a contrivance which measures the hydrostatic pressure near the bottom of the supply tank. Built in accordance with the underlying principle of the venturi tube, flow meters reveal to the pilot at any instant just how much fuel has been consumed.

In respect to timepieces they are made with special consideration of the hard usage to which they are subject from sudden jarring in "taking off" and in landing.

A species of airplane equipment necessary in seeking high altitude records is the oxygen apparatus without which the pilot could not live in the rarified atmosphere above us. While there are three types, chemical liquid and compressed oxygen only the latter has been used in America. In this kind the flow of oxygen is controlled automatically for supplying the exact amount

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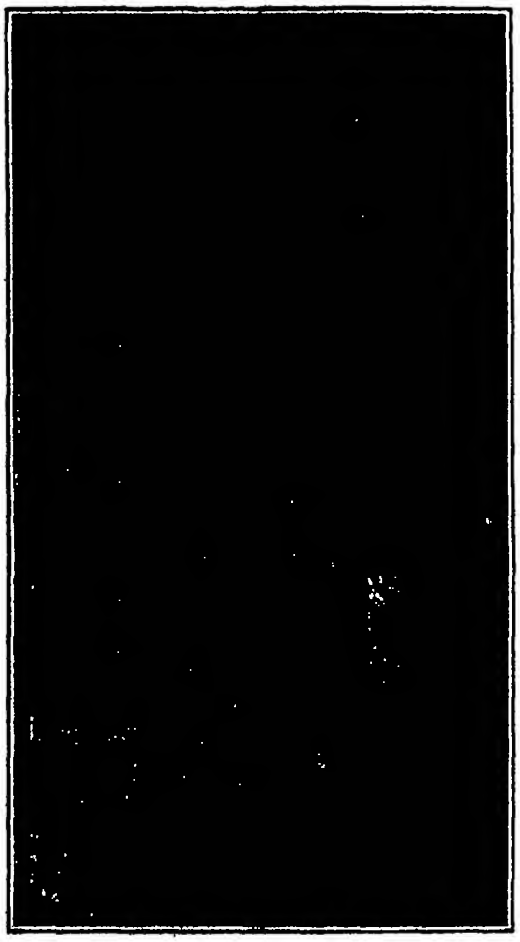


The Jolibois apparatus for rapid and accurate proportioning of liquid mixtures

Mixing Liquids by Machine

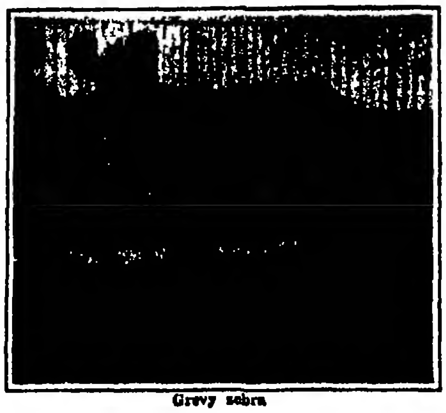
By Jacques Boyer

In the laboratory certain difficulties are met in effecting the quick and homogeneous mixing of two liquids. M. Pierre Jolibois, professor of chemistry at the Polytechnic School, Paris, has invented a very simple apparatus for this purpose. The principle upon which it is based consists in directing through the two branches of a Y shaped glass tube, the two liquids which mix with each other in the end tube.

By means of faucets, the flow is regulated in order to obtain each liquid in the desired proportion in the resultant mixture.

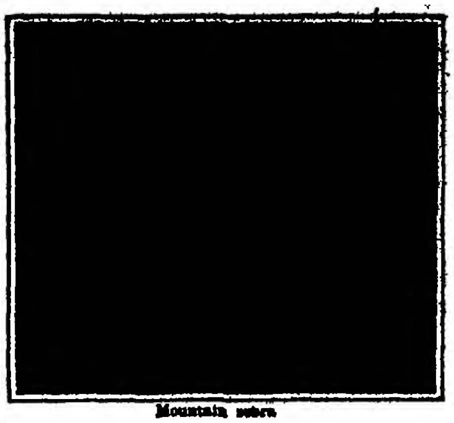
In order to measure the flow, the admission of air in the vials which contain them is effected through a graded venturi tube. By selecting a rapid colored reaction it is possible to ascertain the speed with which the two liquids mix. Let us put for instance, in the left branch a solution of permanganate of potassium at 1.58 grams per liter and in the right branch a solution of ferro-silver at 15 grams per liter and containing 50 cubic centimeters of concentrated sulfuric acid and 10 grams of sulfate of manganese per liter. The discoloration of the permanganate by this liquor is effected to the point of homogeneity in 0.04 to 1.2 seconds, according to the diameter of the tubes.

The liquid is sensibly homogeneous in those parts of the tube where it is colorless, and it is shown by this test that homogeneity is attained the sooner when the tube is thinnest. The method invented by M. Jolibois thus allows to operate very quickly, and by changing the form of the branches of the Y tube he has even been able to obtain the homogeneous mixture of two miscible liquids in the one-hundredth part of a second. This apparatus will be of great use to chemists for studying the speed of quick reactions between liquids.



Grevy zebra

Grant zebra



Mountain zebra

Three diverse species of the zebra to be found in New York Zoological Park

Zebras in New York

What the Metropolis Can Show in These Striped Creatures Which Are Less Docile than They Look

By William T. Hornaday

Illustrations by New York Zoological Society

WHEN Mother Nature finished making the first zebra, she must have smiled complacently, and taken pride unto herself on having done a fine job of wild animal painting. Even in her most joyous and sportive mood, it does not appear that she ever "laid herself out" more thoroughly in the decoration of quadrupeds than in her three species of zebra so long maintained for the millions to see at the New York Zoological Park.

Every zoological park manager perpetually is torn in spirit and harassed in mind by the rude hand of Death. All too frequently an animal of great rarity and beauty, that has been caught in a far distant wilderness and transported painfully and expensively over five or ten thousand miles of land and sea, at last reaches its Antelope House, or Ape House, only to lie down and die in its first ten days in its new home

But zebras are different,—thank heaven! They have good appetites, good nerves and strong lungs, and they do not lie down and die, literally "at the drop of a hat." When they reach their zoo homes they gladly leave their boxes, they stretch their muscles, lie down and roll over, then cheerfully prepare to live long and enjoy life A zebra nearly always gives his owner a good run for his money

But really, it is astonishing to note how many distinguished African travelers traversed and criss-crossed the home ranches of the various zebras of Africa, for years and years, without noting or reporting the existence of several strongly marked species For a period of fifty years or more the world was left to suppose that there was just one species of zebra whereas the Grevy species is so remarkably different from all others that even a child could have noticed it, and recorded it. I will not be so cruel as to record here the names of the great and small travelers who penetrated many times over, the home country of the Grevy zebra without having discovered its separate identity

But at all events, the wonderful Grevy zebra, the largest, the most bizarre and the most striking in form and in color of all the zebra species never was recognized until 1882, when Jules Grevy was president of France. In that year King Menelik sent to President Grevy a living specimen, which, after being for a time confounded with the zebra of South Africa, finally was recognized as an entirely new species and was so described.

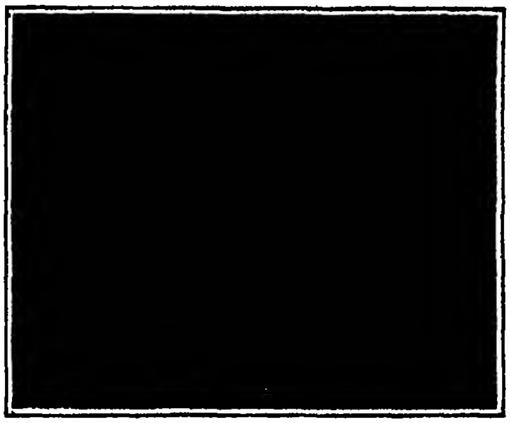
Moral *In those days Science was slow in sending out trained collectors, and this must not again occur!*

The Grevy zebra is recognizable at one glance by its complete coat of very narrow and intense black and white stripes, its large size and enormous ears. It is about one-fifth larger than the other zebra species. Briefly described, its home country is northeastern British East Africa and southern Abyssinia This is the region midway between the great central lakes of Africa and the eastern sea coast To find it in British East Africa it is necessary to go north to the Tana River and Mount Kenia. It is beyond the field of the average safari, and in collections of American sportsmen you see many Grant zebra heads, but few Grevy

The two fine specimens of *Equus grevyi* now in New York have been in the Zoological Park for eleven years, and they are yet going strong. They are the star exhibits of the zebra and wild horse collection Although theoretically they are "a pair," that relationship exists only upon paper The male is so savage that we never have dared to quarter them in the same corral, even for one day The male would either kill the female, or cause her death.

Once our official photographer, Mr E. R. Sanborn, did for the Zoological Society a shrewd stunt Knowing well the savage and dangerous character of the Grevy zebra stallion, he procured a keeper's uniform and with it made an excellent dummy keeper This figure he firmly tied to the fence in the zebra's corral, set up his motion camera, and gave the signal to open the door

The zebra rushed out to the middle of the yard, glared about him, saw the dummy keeper, and was fooled With open mouth and a raucous scream he rushed for the doomed dummy-keeper, seized him by the head, bit him savagely, then grabbed him by the breast With a mighty wrench he tore the dummy from the fence and flung it into the center of the corral.



Adult and young, Grant zebra

There he bit it, tore at its excelsior flesh, then knelt upon its chest and continued to tear at its alleged face with his teeth. The dummy was literally torn to pieces, and even on the screen it was a fearsome sight.

And when we saw it, we congratulated ourselves upon having had sufficient horse sense, in spite of all temptations, to keep that raging demon from the Grevy mare The money value of a Grevy zebra is $2,000, but the exhibition value of an acclimatized and thoroughly settled adult specimen is all of $10,000.

There is now a well recognized group of zebra species known to naturalists as "the Burchell group." Its central and dominant figure is "the true Burchell" zebra, (*Equus burchelli*), with legs all white or nearly so. Around that type species stand, as so many subspecies, the Grant zebra, Chapman zebra, Crawshay's, Selous', and possibly others. The Burchell original is marked by its nearly-white legs, and by the fact that on the hindquarters, where the black and white stripes are widest, the broadest of the white stripes have a faint wash of dark color drawn along their centre line. These are known as "shadow stripes." They are well defined on the Chapman sub-species, but are not visible on the Grant

The Grant zebra is very common in British East Africa, and also one of the most common in captivity In the Zoological Park it breeds persistently and its colts mature well. If there is any young hoofed animal more handsome or more "fetching" than a Grant zebra colt, the world will be pleased to consider it.

We regret to say that on the Athi Plains in British East Africa, and in other places, the Grant zebra herds are to the struggling farmers a serious pest. The farmers say that no farm fence is sufficient to keep a herd of truculent and hungry zebras out of a field of grain Even barbed wire does not stop them, and when a man has the nerve to try to do farming in the wilds of Africa, his claim for protection against spoliation by wild beasts is not to be ignored. The zebra herds are being treated as pests and the farmers of British East Africa are killing them down to reasonable limits, literally in self defense

The Mountain zebra is the rarest species that ever comes into captivity It is from the rough and mountainous regions of South Africa, and it is so nearly extinct that at the last report from its home country only about 400 had remained. By great good fortune, there is just one line by which this stock can be drawn upon for exhibition purposes, without in the least even threatening the extermination of the species. Each year one or two colts are caught, and by this means the Zoological Society expects to maintain its exhibit. The female specimen that for eleven years lived in New York died in 1918, but a new specimen is expected to arrive from Cape Colony soon.

Experiments with Pulp from Australian Hard Woods

EXPERIMENTS by the Forest Products Laboratory at Perth, West Australia, establish the fact that the pulps from mountain ash (Victoria), blackbutt, spotted gum, mountain gum (New South Wales), karri (West Australia), and silky oak (Queensland) are all suitable for paper making. While silky oak returned the most excellent results, the quantity of this timber is very limited.

The experiments indicate that these hardwood papers are much stronger in almost every respect than a series of imported good office envelope and bond papers taken at random from the laboratory stock. The specimen paper from pulp of mountain ash was found to be 1.2 pounds per thousandth inch stronger in bursting strength and considerably stronger in breaking strain than the choice imported papers.

Summarized, the report shows that, (1) The beating of hardwood pulps has a very marked effect upon the paper produced from them; (2) paper stock suitable for numerous uses is obtained by a proper beating treatment, (3) paper produced from the pulp of eucalyptus, after having received the prescribed beating, is equally as strong and in some cases stronger than good imported bond; (4) blending to give strength to the paper is not necessary, provided the pulp has received proper treatment prior to running over the machine; (5) in color, feel, and rattle these hardwood papers are similar to the bleached papers commonly used for stationery.

The wing-load indicator, with the needle at "1" indicating normal horizontal flight

Indicating the Safety Factor

THE pilot is limited in the freedom of maneuverability of the airplane above all by the danger zone, this is the strength limit of the airplane. To go beyond this limit is to break the weight-carrying members.

Until now air pilots have had no absolute guide whereby they could judge the different wing strains (stresses) in their approach toward the danger point or ultimate stress. They relied solely on their feeling. During flight the stresses of the plane fluctuate constantly. We recognize the existence of these fluctuations in stresses without exactly knowing their forces. However, the ultimate breaking stress of the weight-carrying members in airplanes is a known factor.

Therefrom arises the great usefulness of a device which will tell the pilot at any time during flight the extent of the stresses on the aerodynamic lift surfaces of his airplane through the air pressure force, and especially during extraordinary maneuvers. By means of such an instrument the pilot is enabled to tell at all times the degree of safety which exists between him and a possible wing break.

Such a device is the Klemperer wing-load indicator. As an invention and construction of a pilot this instrument embodies all the necessities for practical flight.

The wing-load indicator has a diameter of 2¾ inches, it weighs 10 ounces. It is just as simple to install this device as it is to install a clock. It is evident, therefore, that this device plays no role as far as the factors of space, weight, and installation are concerned.

This indicator is installed on the instrument board or on the fuselage, behind the windshield. It indicates how many times the wing load has risen or fallen above or below the straight horizontal "flight load" value. If the needle in the indicator points to "2," it shows that the weight-carrying members are carrying, on the average, twice the load had in normal flight. When the airplane has a safety factor of 5 and the indicator points to 2, then the pilot still has a good 2½ safety margin. At the moment when the indicator points to 5, then the pilot must expect the inevitable collapse of the aerodynamic lift surfaces.

When the plane is at rest on the ground in a horizontal position, the instrument points to 1, just as though it were in normal horizontal flight.

While starting and landing the instrument will indicate all landing gear ground bumps. In order to protect the instrument from any damage during the take off, it is equipped (like a compass) with a button which, with a simple turn, may *open or close* the instrument.

Gyratory rock-crusher that runs without gears

Flexible Hose for Loading at Sea

THE illustration depicts a new form of all metal loading hose which has recently been put on the market by an eastern firm. Tankers taking on cargo in southern waters are often obliged to anchor some distance out at sea, due to inadequate docking facilities. Loading is then accomplished by laying a ten-inch pipe along the sea bottom to the point where the tanker is to load. At this point a heavy rubber hose long enough to come up over the side of the ship, is attached. When loading is finished the hose is dropped overboard and the spot marked by a buoy.

The life of this hose is comparatively short being about six or seven months, also it requires constant attention. The cost of the new all metal hose is a trifle more than twice as much per foot, but its life is measured in years. In fact, it is guaranteed for ten years. The weight per lineal foot is comparatively the same.

The metal hose is as flexible as, if not more so than, heavy rubber hose. With 120 feet of the hose one and one-half complete turns can be made. By reason of the ingenious locking device embodied in the design of these joints the line may be instantly disconnected at any part of its length. A special bronze having remarkable corrosion-resisting properties is used in the construction of these joints.

A Gearless Rock-Crusher

GEARS, which have always been an essential feature of gyratory rock-crushers, are eliminated in the machine pictured herewith, a highly developed secondary or re-crushing unit, designed to produce finely crushed rock at rapid speed and low cost. The absence of gears permits higher crushing speeds without adding mechanical complication to the machine.

This machine contains a ball joint eccentric, which itself constitutes an important advance in crusher design, as it maintains better alinement of the main shaft than had been possible before. The machine has a highly arched spider, permitting the passage of any *stone that will enter the machine. In addition to all* this, the direct drive with all its advantages is now employed. The driving power is applied through a universal device that eliminates all friction and side strain, and relieves the grinding and side-thrust common to most gyratory crushers.

On test, one of these machines was driven for 36 hours at double its rated speed, and at the end of this test the eccentric had barely attained blood heat. The capacity, it should be noted, is well above that obtained with standard geared crushers.

Why the Sea is Salt

SEA water contains an enormous amount of mineral salts, no less than about 3.5 per cent. If the ocean were entirely evaporated the amount of salt left behind would be sufficient to cover the entire earth with a layer 60 metres deep. It used to be thought that the salt in the ocean was dissolved out of the rocks forming the continents by rain water and carried down to the sea by the rivers. But this theory is not tenable for various reasons. For one thing the salts contained in solution in the water of streams contain about 80 per cent of calcium carbonate and only 7 per cent of compounds containing chloride, whereas 89 per cent of the mineral compounds contained in ocean water consists of sea salt. Furthermore when rivers are cut off so as to form landlocked lakes which afterwards dry out, the stratified layers of mineral salts which are formed differ in composition from sea salt.

Modern geologists, therefore, according to *Ciel et Terre* (Paris), consider the salinity of the ocean as an original instead of a derived condition. Suess has a theory that the mineral compounds found in the ocean water to-day proceed from the volcanic eruptions which took place in the early stages of the formation of our earth. Whenever such a volcanic eruption takes place in our own time water vapor, carbon dioxide, and gaseous compounds containing chlorine and sulphur are ejected into the atmosphere and are finally brought down to the ocean by means of rain. After each eruption of Vesuvius the crater is found to be covered with a gleaming white crust of sea salt while the volcanoes of South America throw out enormous quantities of hydrochloric acid, the Puracé alone being estimated to eject 30 000 kg of this compound. This volcanic activity is confined to only a few points upon the globe in our era, but it must have been very general in those primeval times before organic life existed upon the earth. It was then that the internal gases broke through the crust bringing with them the vast amount of chlorides which we find to-day in sea water.

Flexible all-metal hose for loading tankers at sea

A Use for Ohio River Mud

FARM mud has at last been put to a good and useful purpose. Mr. Louis Kuertz, a farmer of Cincinnati, has found that the mud on his place when mixed to a homogeneous mass makes excellent molds for garden lamps and benches. He takes the sticky mud and piles it up in odd fashion, holding it in place as he builds it up in the form of a mold with big rocks, stones and pieces of wood. In the case of forming the garden lamps an irregular core is left in the center by the chunks of mud as he piles it up and into this cavity he fills the liquid cement and gravel which, of course, takes on the form of the mold and sets. Garden benches are molded in the same fashion, usually in two sections, the top and bottom bench part.

To avoid the finished products being all of a gray cement color, coloring matter is sprayed on in a thin coat over all. No two lamps or benches are ever exactly alike, because of the nature of forming the mud molds.

A Cincinnati farmer makes ornamental use of the mud on his place

Some New Mechanical Amusement Devices

(Continued from page 269)

cars could never expect to accomplish

Games of chance have been replaced almost entirely by games in which the skill of the several customers of the concession in question are matched Typical of this is a game called the Yacht Race A number of tiny yachts are mounted on tracks, each in a separate glass case These glass cases are mounted one above the other At the front of the stand are several wind pumps each connected with one of the yacht cases At a given signal each customer starts to turn his pump and the resulting air pressure drives his yacht along from one end of the case to the other The one who succeeds in pumping the most air gets his ship to the end first and wins the box of candy

A combination of airplane and boating sensations is found in a nameless device which consists of a series of baskets mounted at the end of long spring arms These are revolved by an electrical motor an oscillating track at the center providing a bouncing motion This bouncing motion is taken up and continued by the springs so that the passenger not only is sailing through the air but also going over waves, so far as his sensations are concerned

People with strong constitutions and plenty of courage will find considerable pleasure ahead of them on the new pier Those less courageous find equal enjoyment watching the other fellow try out the various devices

A Centrifugal Concrete Mixer

(Continued from page 269)

producing concretes of like consistency or flowability, the strength of the two mixtures are not at such wide variance The excessive mixing action of the new apparatus is advantageous insofar as it speeds the execution of the job

Testing the Purity of Quinine

A CERTAIN corporation in Turkey had occasion during the war to determine the degree of effectiveness of the preparation of quinine coming from three different manufacturers. Owing to the primitive nature of the facilities at their disposal it was impossible to make a chemical test with respect to the content of effective alkaloid An ingenious way was found out of this difficulty by observing the mental effects produced by the drug

The method of investigation was so planned as to include not merely the testing of the effectiveness of the quinine preparations but as to investigate, likewise the magnitude of the mental effect of the quinine when given in prophylactic doses and the duration of the said influence The conclusions reached were of significance with respect to the capacity for the performance of work of soldiers in active service For example, one of the tests given was the capacity of perception of nine letters of the alphabet arranged in the form of a square behind the photographic slit the shutter being left open from 1/10 to 1/100 of a second For testing the capacity of attention and at the same time the degree of fatigue, the ordinary crossing-out test and also the Kraepelin counting diagram were employed Testing the degree of deafness and the buzzing of the ears was done by means of a Galton pitch pipe and by whispering, and finally the sense of time was tested by requiring the subject to make beats at intervals of about half a minute

All three of the preparations of quinine occasioned a slightly disturbed mental condition with an apparent increase in capacity for work done, but it was definitely proved that one of the three preparations of quinine available was considerably more energetic in its effect than the other two.

Saving Uncle Sam's Pennies

(Continued from page 272)

water power should be brought together in a new Department of Public Works.

The question is a natural one, will the work of the Bureau of Efficiency reduce the burden of taxation? My answer is Yes. But, frankly, the reduction will be so small as to be imperceptible in the tax bill of the individual I will explain why

The total amount appropriated for the maintenance of the Government for the fiscal year 1921 (exclusive of the Postal Service which is almost self-supporting, and exclusive of deficiencies on account of the fiscal year 1920) was $4,175,820 089 Of this amount $2,888,118 400, or about 68 per cent, was for the payment of obligations incurred on account of past wars chiefly the recent war with Germany such as compensation for death, disability, vocational training hospital treatment, return of remains from France, pensions interest on the public debt, sinking fund, and Federal operation of railroads. In addition the appropriations for national defense to cover the period from July 1, 1920 to June 30, 1921, were $855,956 968.

Now the sum of these two expenditures represents over 88 per cent of the money appropriated by Congress for the conduct of the public business during the fiscal year 1921, exclusive of the Postal Service and deficiencies on account of 1920 This means that less than 12 per cent ($481 744 726) of that total of more than four billions is to be spent on the works of peace—that is, on paying for the development of commerce, agriculture, science research, education, public health and public works of one kind and another, salaries of the administrative officers and clerical assistants of the Government Departments and of the Federal courts and the salaries and expenses of the Congress itself The Bureau's operations are confined to this 12 per cent Amounts running into the millions are in themselves well worth saving but it will be readily seen that the saving the Bureau can compass for the individual taxpayers will not be very noticeable

I do not wish to minimize the importance of eliminating all waste in the civil establishments of the Government I would do away with every scrap of duplication, every shadow of overlapping I would reorganize the Departmental service in accordance with the best practices of modern business I would have the people get full returns on every penny expended in running the Government offices But what I want to be understood and understood clearly is that whittle away as we may, our Bureau can only reduce the total public expenditures by perhaps a fraction of one per cent

More than 88 per cent of the money spent by the Government during the next year will be on account of past and future wars So long as we wish to maintain a military establishment of 300 000 officers and enlisted men, so long as we feel the necessity of building and maintaining a navy of the first rank, high taxes are inevitable I am not discussing the merits of the military and naval programs. All I wish to say is that if we want to make really big reductions in appropriations, about the only place that that can be done is in the appropriations for our military and naval establishments. The decision as to whether this is desirable must be made by the people of the country as a whole.

Blast Furnace Slag

(Continued from page 272)

that only the slag which had a glassy appearance was suitable for making cement Glassy slag is obtained by rapidly cooling and seems to retain its latent hydraulic properties, while slag which is cooled slowly does not possess the property of setting. Then it was established that in the case of granulated slag, the property of setting could be developed by the addition of a suitable amount of lime. At the present [illegible] slag cement contains about [illegible] per cent lime and [illegible] per cent of granulated slag. This mixture is burnt in rotary kilns, just as is done in the case of regular cement. Another variety of slag cement is called iron slag cement, which contains about 30 per cent slag and 70 per cent of portland cement clinker. This cement stands between regular cement and straight slag cement and is made by burning a mixture of slag and limestone

The ordinary process of making building stones from slag is to mix together slag sand lime and a little foundry sand The binding action of the slag gives a stone which has a high mechanical resistance, about 100 to 200 kilograms per square cm A method of causing the stones to harden quickly is to place them in the path of the exhaust gases from the internal combustion engines which drive the blast furnace blowers, and are rich in carbon dioxide and water vapor

Light stone is made in the same manner as slag stone, with the exception that particularly light granulated slag is used as a filler, and as the binding material not just lime but a mixture of lime and ground slag, in other words slag cement, is used This mixture is compressed in forms and attains a mechanical resistance in the stone of 10 to 25 kilograms per sq cm Both slag stone and light stone are very useful and economical building stones, the former as a substitute for ordinary brick and the latter instead of sand stone.

The author has experimented considerably in an attempt to transform the slag which is unsuited for these purposes into the kind that is suited A very acid slag was treated with lime, while being heated, and then with lime and alumina again in order to obtain a slag which has a higher lime content The melting of the slag was accomplished in an electric furnace After many experiments it was possible, by putting it through this process to make the acid slag capable of setting The cement that was made with it possesses solidity and when both lime and alumina were added, the strength of the cement was increased over ten times that of the original value The slag which was valueless beforehand was converted into a useable form in this way

Our Latest Science

(Continued from page 275)

holding its own The next stage is the no-child marriage and the extinction of the stock which laid the foundations of our republican institutions

Professor Osborn, who was recently in Europe bringing together leaders in eugenics and biology from many European countries to attend the Congress, said that he had made a special study of parts of Belgium and France. Here he had been impressed, he said, with the manner in which the three main races of France, the Mediterranean, the Alpine and the Nordic, preserved their racial traits. He said that 12,000 years of similar environment and 1,000 years of similar education had caused only a slight divergence from the characteristics which were found in those races many thousands of years ago, as shown by evidences in the remains surviving from that period.

The difficulty in obtaining legislation to better the races, because of various prejudices and because of the fear on the part of politicians to give offence to any of their constituents, was emphasized by several speakers. Major Leonard Darwin said that it was very difficult to induce law-makers to pass laws for the benefit of the unborn who have no votes. Dr. Davenport said that the study of [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the general [illegible] [illegible] [illegible] [illegible] a [illegible]. The [illegible]

that of charts, photographs, paintings, books, etc., held in Forestry Hall is most interesting and will be open for a month. The meetings are not over as we go to press and more interesting papers may be looked for

The Aviator's Tell Tales

(*Continued from page 275*)

of gas needed at various stages of ascent to enable the aviator to breathe under normal condition. A curious fact in connection with this instrument is that there are only nine in existence in this country. That number had been made at the signing of the armistice, and the government countermanded the rest of the order in the hands of the manufacturer

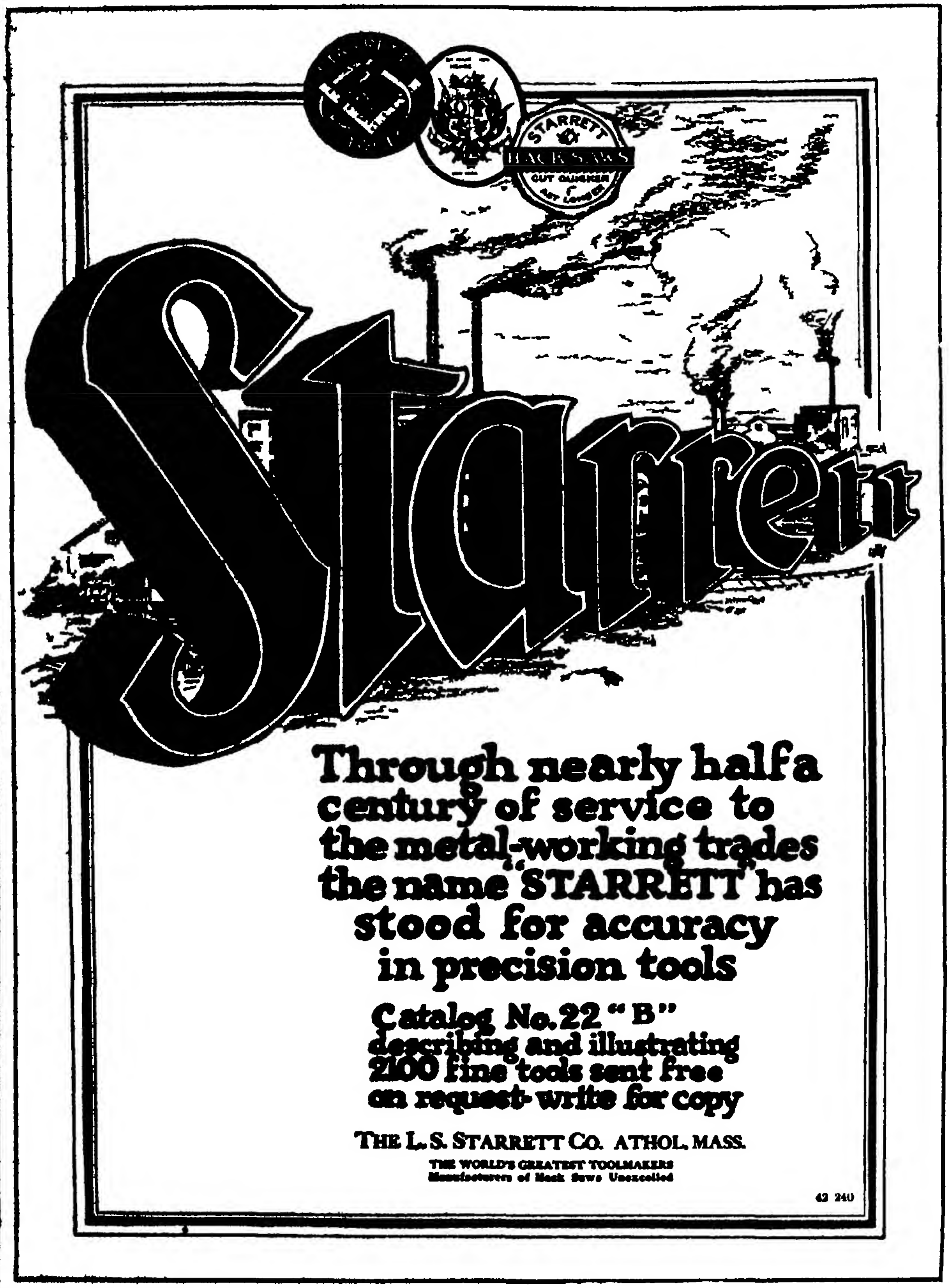
Drift indicators show the angle measurement when an airplane deviates from a set course caused by the action of cross winds. In one form of instrument readings may be obtained of the ground speed as well, and from heights of 500 to 20 000 feet. Broadly speaking the operation consists of observing through an eyepiece on a vertical arm objects below which appear between two cross wires. Knowledge of the altitude, timing of the passage of an object from one wire to another and the use of a table of figures give the speed in miles per hour. In reading the drift on the same instrument the pilot observes objects seeming to travel along a wire passing through the two cross wires and notes the results on a scale.

Soil Acidity

MR. W H MacINTIRE of the University of Tennessee Agricultural Experiment Station, presents in the *Journal of the American Society of Agronomy* a very complete article on the nature of soil acidity

No one phase of soil chemistry the author says, has received more attention in recent years than the problem variously referred to as lime requirement soil acidity or lime-absorption coefficient. The problem can hardly be considered however as having solely a chemical or physico-chemical basis in its relation to soil fertility for it is closely correlated with, if not inseparable from, both bacteriological and plant physiological considerations.

The author summarises in part (1) Although salts of a number of organic acids have been isolated from soils, no one definite free organic acid has ever been extracted as of record (2) Certain salts produce a decrease of soil acidity (sodium nitrate potassium nitrate, etc) though in laboratory treatment during short periods followed by extractions, the reverse may be true (3) Removal, or absorption, of dissolved bases by soils appeared to be a chemical function of acid silicates, principally alumino-silicates, the extent of whose hydration is a controlling factor in initial intensity and continuity of reaction (4) The acidity of soils is in the main, induced by the loss of calcic and magnesic inorganic salts, derived originally from the hydrolysis of the alkali-earth siliceous complexes, thereby increasing the acid properties or amount of acid silicates. (5) Silicic acid in mass, will progressively hydrolize and continue to decompose calcium and magnesium carbonate when the liberated CO_2 is removed from solution. (6) After intense alkali treatments and the removal of excess of hydrogen and after intense heating pure silica, silicates, and titanium oxide will, on the addition of H_2O hydrolyze and act towards the alkali earth bases (7) The injurious effect of acidity may be attributed, in some instances, to aluminum and other toxic salts, but, in general more particularly to the diminished supply of available calcium from the depleted lime content of the soil, [illegible] of the [illegible] and the [illegible] as plant food, or [illegible]



Starrett Adds Two New Radius and Fillet Gages to Line

Two new Starrett Fillet or Radius Gages, recently added to the Starrett line, are now being introduced by hardware dealers to the metal working trades.

One of these gages, No 272M is generally similar to the well known No 272 Starrett Fillet and Radius Gage, but is made in metric measure. Two sizes are furnished, Size A, having 18 leaves, from 12 to 1 mm., and Size B with 16 leaves, ranging from 5.5 to 13 mm. As with No. 272 this gage will be found very useful for quickly obtaining the radii of fillets corners etc. It can be used in any position or at any angle the formation of the gage also allowing it to be used up to a shoulder and for duplicating sample pieces The stud holding the blades in place are eccentric with the round end of the case. This is of advantage since it causes the edge of the case to stand well away from the edge of the leaves when the case is opened.

Second of the two gages referred to in the first paragraph is the New Starrett Fillet or Radius Gage No 279 This gage is similar in general design to the Starrett Gage No 272 except that it has twenty leaves with radii from 020 to 400 inch inclusive. Nine of these cases have concave and convex radii from 020 to 100 inclusive by 010 inch 4 leaves have concave and convex radii from 025 inch one leaf with concave and convex radii of .250 inch three leaves with concave radii only from 300 to 400 inclusive by 050 inch and three leaves with convex radii only from .300 to 400 by 050 inch.

Other details with illustrations of these Starrett gages are given in the new Starrett Catalog No 22 B Copies of this catalog may be obtained on request from The L. S Starrett Company Athol Mass

The Diver from a Biological Point of View

THE physiological studies of the effects of various forms of athletic activities made by the French scientist, M. Marcel Thooris have been attracting some attention abroad and are well worth consideration on the part of our own coaches, men and other athletes One of his more recent reports concerns his observations of two divers Pouliquen and de Lalyman.

As a result of the study of these two expert divers he concludes that a man immersed in water must render his respiratory apparatus immobile in order to avoid the entrance of the water into his windpipe during the act of inspiration As a matter of fact the thoracic tracing becomes practically a horizontal straight line during the submersion resembling that made by a continuous vowel sound But after the lapse of about thirty seconds a difference is observed in the tracings recording the movements of the chest nose and larynx Three principal factors are noted here The periodical expansion and contraction of the thorax the singular mobility of the soft palate and the free displacement of the larynx

To sum the matter up each period is characterized by the following phenomena —an initial inspiration with a blocking of the air passages by the soft palate a rise of the larynx accompanied by a synergetic construction of the glottis an expiration emphasizing the descent of the larynx which is synergetic with the expansion of the glottis During the inspiration communication with the outside air is completely interrupted but during expiration there is such a communication in a fleeting and interrupted manner During the act of expiration the diver comes out of the water He then takes several rapid and short breaths (amplitude 7 mm and frequently 8 in 20 seconds) before recovering his usual rhythm and the normal amplitude (22 mm)

X ray photographs showed an abrupt rising motion of the thyroid cartilage and a periodic expansion of the thorax

M Thooris finds from his observations and his personal experiments that the need to breathe while under the water does not become imperative until about 30 seconds have elapsed at the end of this time the chest isolated from the external air goes through the same motions of expansion and contraction normal to it in the air But these alternating motions can be accomplished in two ways only—either by *straining motions* (Mouvements d effort) or by swallowing motions But the former exhaust the diver so that the latter are resorted to by experts.

A trained diver is capable of remaining several minutes under water and while this depends partly upon individual elasticity it also depends upon the manner in which the diver responds to the need of respiration which oppresses him This need comprises three factors according to M Thooris, which in the order of their urgency are The alternate need of expansion and of contraction of the thorax the need of eliminating carbon dioxide, the need of oxygen The first of these is mechanical and depends upon the will the second is chemical and automatic

The biological process concerned in the act of diving consists of three phases The act of inspiration with the closing of the soft palate the rise of the larynx with synergetic construction of the glottis expiration with fall of the larynx and expansion of the glottis and of the soft palate.

A practical result of these studies is found in the fact that the understanding thus gained of the physiological mechanism of the act of diving greatly facilitates instruction in its technique Finally M Thooris points out that the safety of all swimmers can be greatly enhanced by methodical training of the ability to remain under water

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SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

35¢ a Copy NOVEMBER 1921 $4.00 a Year

THE STEADY HAND AND THE WATCHFUL EYE IN THE CAB OF AN ELECTRIC LOCOMOTIVE

That Careless Request

"GIVE ME A QUARTS OF OIL"

must go!

THE motorist who says, "Give me a quart of oil" is inviting trouble He is inviting the garage man to put in his car incorrect oil—inferior oil—hit-or miss lubrication The motorist who makes this dangerous request says, in effect

1 **"I don't care whether my oil really suits my engine"** The lubricating requirements of two automobile engines may differ widely Bore and stroke; valve construction; number and fit of piston rings; piston design; cooling system and many other factors must be considered before oil of correct body can be determined for a given engine

2 **"I don't care about protection, compression, gasoline and oil economy or freedom from carbon troubles"** "Give me a quart of oil" disregards entirely the necessity for free distribution of the oil to all moving parts It overlooks heat conditions, cold-weather requirements and piston ring seal

3 **"I don't care who made the oil."** Many "quarts of oil" are mere by-products in the production of gasoline and kerosene Gargoyle Mobiloils are the specialized products of the recognized world leaders in scientific lubrication—the Vacuum Oil Company

* * *

Only one oil is best for your car That is absolute The Chart printed here is the scientific guide to correct lubrication The grade of Gargoyle Mobiloils listed for your car was specified only after thorough analysis of the requirements of your engine

That grade of Gargoyle Mobiloils will give you full protection to your engine, full compression, gasoline and oil economy, freedom from carbon troubles and fewer repair bills.

To avoid substitution we advise that you buy in the original sealed containers

If your car is not listed in the partial Chart shown here, send for our booklet, "Correct Lubrication" It contains the complete Chart which specifies the correct oil for every make and model After reading this Booklet you will understand why "Give me a quart of oil" causes at least 50% of all engine troubles. In writing for the Booklet, please address our nearest Branch

GARGOYLE

Mobiloils

A grade for each type of motor

Domestic Branches:
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VACUUM OIL COMPANY

[illegible] Recommendations

How to Read the Chart

[illegible]

A means Gargoyle Mobiloil [illegible]
B means Gargoyle Mobiloil [illegible]
E means Gargoyle Mobiloil [illegible]
Arc means Gargoyle Mobiloil Arctic

[illegible]

The Chart of Recommendations is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and represents our professional advice on correct automobile lubrication.

NAMES OF AUTOMOBILES AND MOTOR TRUCKS	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

The Scientific American, November, 1921 Volume 125-A, Number 17. Published monthly by Scientific American Publishing Company at 233 Broadway New York N Y Subscription price [illegible] per year Entered as second-class matter June 18, 1919, at the post office at New York N Y under the act of March 3 1879

With the Editors

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NOVEMBER, 1921

LEADING ARTICLES

SHORT ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY

Munn & Company, 233 Broadway, New York

Founded 1845

CHARLES ALLEN MUNN President ORSON D MUNN Treasurer

ALLAN C. HOFFMAN Secretary

Vol. 125-A, No. 17. Published monthly Entered as second class matter, June 18 1879, at the post office at New York, N Y., under the Act of March 3, 1879

Price, 35 cents a copy $4 00 a year Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5 00 a year postage prepaid.

HERE is the initial issue of the new monthly SCIENTIFIC AMERICAN—a combination of the former weekly SCIENTIFIC AMERICAN and the SCIENTIFIC AMERICAN MONTHLY Considering the strenuous conditions under which we labored in getting this number together, we are rather pleased with our product, especially now that we can turn over the page proofs and visualize what the finished copy will be like. Please pardon our seeming self-praise, but here is what had to be done First of all, the regular weekly SCIENTIFIC AMERICAN had to be continued week by week up to the issue of October 15th. Secondly, we had to turn out the former SCIENTIFIC AMERICAN MONTHLY, with all its mass of original and abstracted material, up till the October issue. Thirdly, we had to strain every resource at our command in order to gather the best material possible for this November issue Three periodicals under way at the same time—twice our normal work! However, if you are pleased with the product, we are amply repaid. Now, with the two former periodicals combined into a single journal, we can concentrate every effort on the big December issue, which will be in your hands by November 20th

SOME weeks ago Hudson Maxim, the distinguished inventor, drove us out to the Edison laboratory in company with Garrett P Serviss, the scientific lecturer and writer Mr Maxim had arranged the gathering, we suspect, with the intent of provoking a discussion of the Einstein theories, which at the moment were in the front of his mind He generally has his way when it comes to determining the subject of conversation, but this occasion was an exception. Mr Edison had something in the front of *his* mind—the questionaire which he had just devised for applicants for employment, and which was just at a point where its successful working was assured. So Mr Edison, with a little assistance from the rest of the gathering, talked questionaires all the afternoon This particular affair was not an interview, since Mr Edison was not at the time ready to talk for publication, but it put us on the trail of the story We have since then had three further talks with Mr Edison and have been allowed to examine a number of the papers written by his candidates. The result is the story that appears on page 16. We know you will find it amusing in spots we hope you will find it instructive and timely as well.

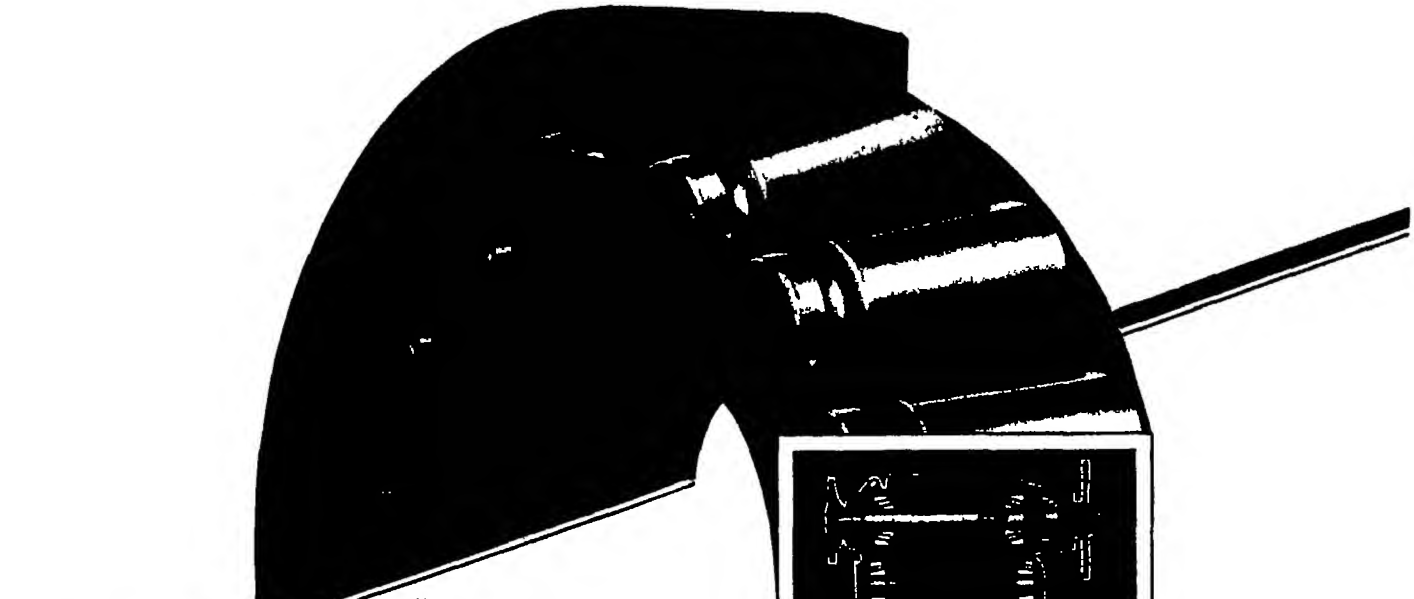
EDITORIAL work, after all is said and done, is not a great deal different from running a store. It is the editor's part to size up his readers and determine what they want, following which he secures the right kind of material and presents it in the most attractive manner Carrying our comparison just a point further, we cannot but feel that there is a great deal of wisdom in that store sign which says "If you don't see what you want, ask for it." Why not use the same sign in editorial work? Much as we endeavor to keep in close touch with the wishes of our readers, there are times when even the closest contact fails to bring any request for very much desired information or editorial comment on some specific subject. Why not, then, "ask for it?"

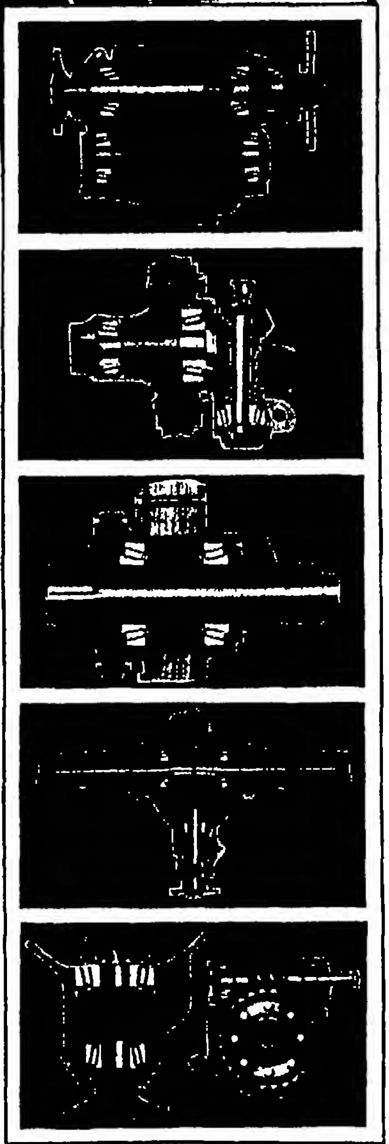
HERE is a little incident which took place "behind the scenes," so to speak, a few weeks ago. A member of our staff, who, over a year ago, wrote about the remarkable Belin system of transmitting photographs, drawings, type matter and other images over wires, received the following telegram: "*Serons reconnaissants bien vouloir nous fair expedier extreme urgence Belmont Hotel Bar Harbor Maine transfermateur genre telephone rapport transfermation un a quinze environ remerciments Belin*" Translated, this says "Would appreciate if you would be good enough to ship us in extreme haste, to Belmont Hotel, Bar Harbor, Maine, a telephone type transformer with transforming ratio of about one to fifteen Thanks Belin We did—the following morning Frankly, we are pleased to play a rôle in such momentous undertakings as the transmission of facsimile messages via radio across the Atlantic Mr Belin recently came here again from France in order to receive drawings, cartoons facsimile messages and other images at Bar Harbor, Maine, from the Lafayette radio station at Bordeaux Of course, we shall get the first complete and authentic data regarding Mr Belin's remarkable experiments—perhaps in time for the December issue

WE are in good company in this November issue Such names as Lindenthal, Simon, Hornaday, Russell and Steinmetz mean a great deal in their respective fields—bridge building, medicine and municipal administration, natural history, astronomy and electrical engineering. We have been most fortunate in securing articles from the pens—or typewriters—of these well-known men Then there are others represented in this issue, even though their thoughts and plans and views are reported by our editorial staff and regular contributors Thus we have Edison's comments on his questionaire, Small, Vice-President of the Underwriters Laboratories, on airplane fatalities and risks, Murray, on his super power zone, and so on. Already we have an imposing list of leaders for the December issue, indeed, every issue of the new monthly SCIENTIFIC AMERICAN must and will be a platform, so to speak, from which leaders in all fields of technology can address the laity, either in person or through one of our staff writers.

FAMILIAR enough is the sage advice, "If you want a thing well done, do it yourself' Of equal standing is the maxim, 'Don't write send ' Perhaps the ideas back of these two old saws might be combined into a new saw,' if there be such a thing If you want to know, go and see" We did want to know something about the condition and the relative merits of the several avenues of automobile communication between east and west we did want to sort out the conflicting testimony about them So one of us volunteered to combine business with pleasure, to the extent of spending his vacation in his "flivver ' We think his report of what he found makes mighty interesting reading You will find it on page 6.

ONE of the novel features of this new form of ours is the almost total freedom from the objectionable line, "Continued on page —— ' Most of our readers will recognize in the freedom with which we now run our articles on to a second or even a third page, the means of avoiding this turn-over expedient Were the SCIENTIFIC AMERICAN just a monthly periodical and nothing more, such turn-overs would matter but little, but, as we learn from a mass of correspondence on this subject in past years, this journal is regarded as a permanent encyclopedia or reference work Many of the articles in its columns are carefully clipped and filed away for future use And the simpler we make that task, the more serviceable becomes our work for a vast host of readers.



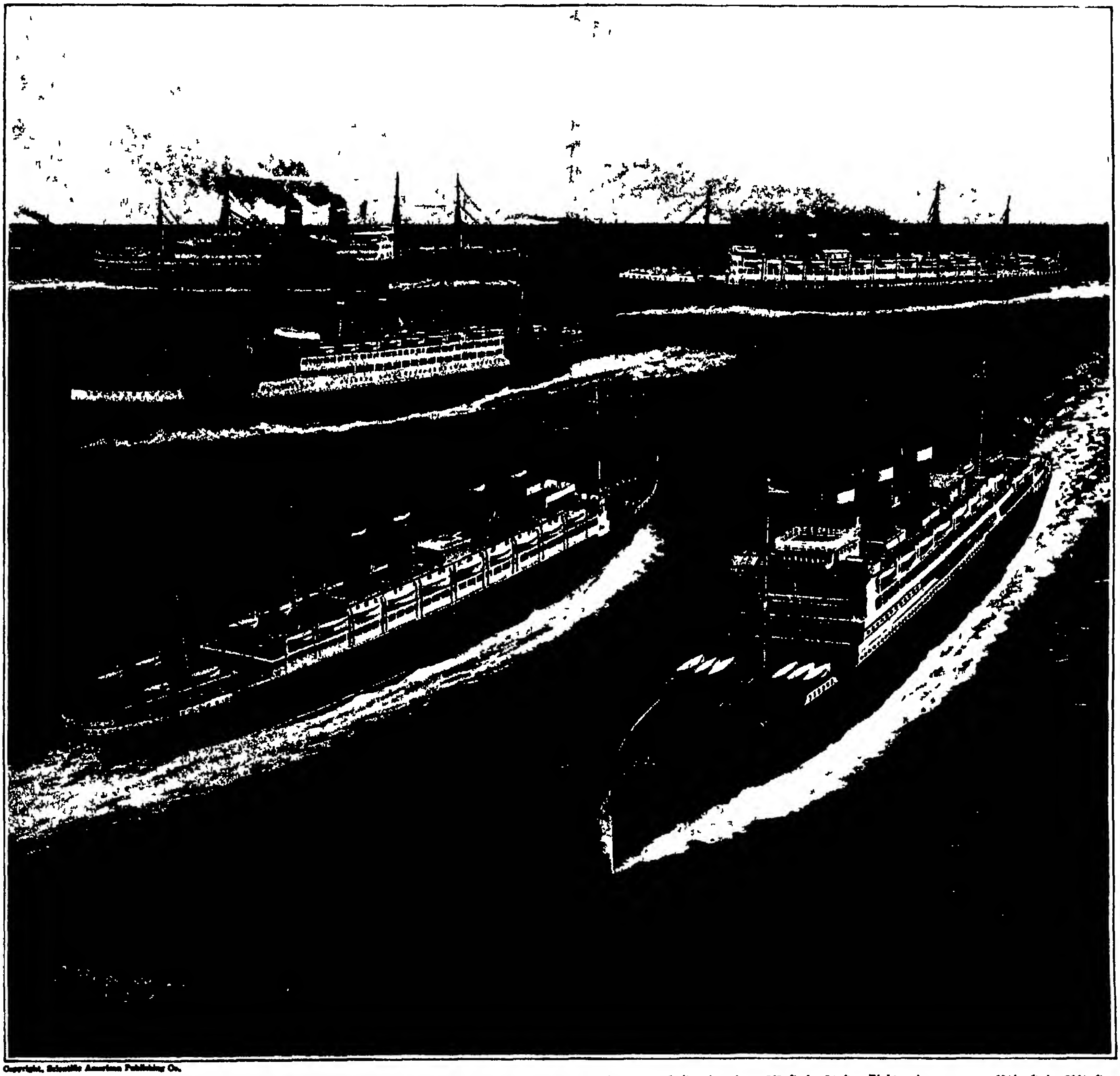


SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, NOVEMBER, 1921



The five great passenger ships of the United States Shipping Board shown above reading from the top down are—*Left:* America 669 ft. by 74 ft *Right* Agamemnon , 684½ ft. by 72½ ft. *Left:* "George Washington , 699 ft. by 78 ft. *Left:* "Mount Vernon', 685½ ft. by 72¼ ft. *Right:* 'Leviathan", 927½ ft. by 100 ft.

"The Big Five" of the United States Shipping Board—(See page 9)

View on the new Federal Road into Austin, Nev., through forest reserve and desert country. The old trail, of which a piece is visible in the gully below the new embankment, had continuous grades of ten and twelve per cent, the maximum on the new is six per cent

Tours and Detours

Impressions of the Through Automobile Highways of the Eastern and Central States

By J. Malcolm Bird

THE last word with regard to ultimate acceptability lies with the ultimate consumer. Our roads just as truly as anything else are an article of manufacture and use; the ultimate consumer is the man who uses them—driver of car, of truck, in less degree of horse. Road building and maintenance, dead from 1917 to 1919, revived in 1920 and regained their health in 1921. During the past summer I have played the part of ultimate consumer over many roads, including some 2,000 *miles of our main intersectional highways.* In view of the prospect that 1922 will see even greater road activity than the past season I venture to set down here my impressions, in the hope that some of them at least will fall on ground not barren.

The outstanding feature of the present condition of our roads is the contrast between town and country. Over the entire length of the Mohawk Trail and less consistently on other routes, city lines are marked by signs informing the motorist that he is entering the corporate limits, that here state supervision of the road ceases. As a study in cause and effect these boards are admirable; as bearers of information they are superfluous. You drive for miles through open country over a velvet highway. Suddenly you are jounced and jerked over a dilapidated brick pavement, or pitched into and out of deep holes in prehistoric macadam, or made to vibrate to the alternate sharps and flats of a block pavement of which no two adjacent blocks by any *chance strike the same level. No sign is needed to* identify this as the city.

The reasons for the condition are obvious enough. Perhaps the road is occupied by a traction line, bound by franchise to keep the street in order. The natural disinclination to smooth the way for automotive competition is bolstered by the fact that the plea of semi-bankruptcy is uncomfortably close to the truth. And in the absence of a trolley company to act the villain, the city fathers, before appropriating $100,000 for two miles of modern concrete on Main Street, demand to be *shown just how and when and whence the money is* coming back.

There are two angles to this situation. On one of them no sympathy is due the local obstructionists. If the merchants of a 20,000 town insist that a main street resembling in general contour the devastated regions of France is good enough for them, they are probably right. For people who are satisfied with that kind of a street, *that* kind of a street is the most fitting reward I can imagine.

The local viewpoint, however, is not entirely wrong. It is not true that nobody from out of town has to use the street if he doesn't want to. In these days of broad interdependence, no community can withdraw into its shell and thus divorce itself from playing its part in the world's business. Cars and trucks from other parts of the state and from other states *do* have to use that street. But it *is* true that in proportion to the degree of such use, the local taxpayer may reason*ably demand freedom from liability for the bills*—until the happy time when *every* community keeps its streets in good shape, putting the matter on a basis of perfectly even exchange.

In driving through seven states over a period of eighteen days, I saw at least twenty-eight different license plates. In one small town I counted eleven among fifty-odd cars parked about the public square. Road commissions and automobile associations try to make the local people see that the money spent by these tourists pays for their use of the streets. But it takes a lot of gas at twenty-odd cents a gallon, vast numbers of tourists supplied with bed and board, a great volume of garage service, before the profits on these enterprises *will match the cost of converting Main Street into a* highway for transcontinental freight and passenger traffic.

Ultimately the matter will be dealt with by mandatory legislation, which will compel the recalcitrant communities to pay their share of the cost of fixing their streets for their own and for other people's use. Until such legislation is general it must be a matter for negotiation. Even on this basis it is not hopeless, if both parties will be reasonable. Announcement was recently made that arrangements had been reached for *the reconstruction of the main street of Downington,* Pa., which in the past has been one of the worst stretches on the Lincoln Highway in the state. I saw concreting in progress, in the neighboring town of Coatesville, on what must have been a close rival of Downington for the place of ultimate dishonor. When Downington is fixed up there will be only one place in the 350 miles between New Brunswick, N. J., and Uniontown, Pa., *where the motorist need feel seriously* put out by bad city pavement—that awful quarter-mile on the outskirts of Morrisville, Pa.

A perfectly maintained macadam section of the Lincoln Highway in Ohio

Ohio, despite the fact that I broke a spring in one of its lake-front towns, is free from serious reproach in the matter of its Main Streets. Incidentally, I derived great spiritual consolation by limping ten miles to the next town to get that spring replaced. Indiana is *in even better case than Ohio, so far as I saw it, though* I did not cover so large a proportion of its territory. The Mohawk Trail is the prime offender; the good pavements of Batavia and Geneva stand out as oases in the drive from Buffalo to Albany. Among the smaller cities, I give the place of honor to Van Wert, O., not alone its pavements, but every detail of the impression it makes on the tourist, is unusually fine. Erie, Pa., seems about the best of the cities of comparable size; one who has seen it only from the train will have difficulty in reconciling the thoroughly disreputable aspect *which it there presents with the fine character of its* residence and business streets. The same thing is true in less measure of Syracuse. Of the first-class cities, I have no hesitation in giving ranking position to Cleveland. I drove clear through, from west to east, during the evening rush hour, in considerably under an hour and with no bad going at all. To one accustomed to doing his city driving in New York and Newark this is a miracle.

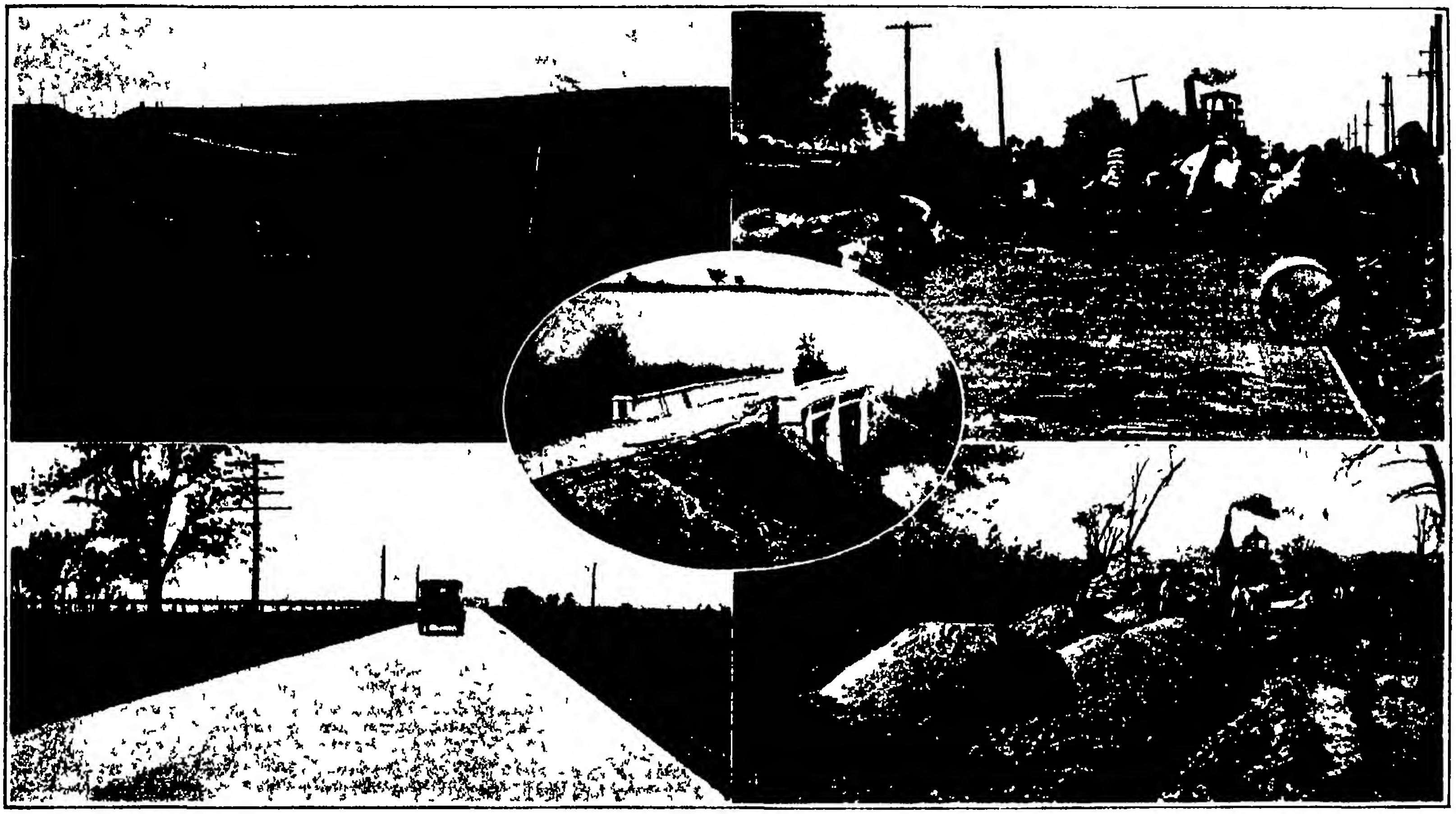
I hope I will not be accused of sectional bias if I say a word in extenuation of Jersey City. Every motorist from out of town who has crossed any of New York's downtown ferries must have unpleasant memories of this part of his trip. But we ought to remember that with the big town just across the river, no driver is going to stop in Jersey City except in dire emergency, so that here more than anywhere else the complaint that good streets don't pay is justified. You do not have to drive through Jersey City to get to New York, *however; go north from Newark, cut across* through Hackensack and Englewood, and use the Dyckman Street or the Ft. Lee Ferry. (The former shuts down during the winter months.) Better yet, go north before coming to Newark, and drive along the Watchung Mountains to Montclair or Paterson, and you will learn something about New Jersey scenery that does not seem to be generally known. I don't suppose the Lincoln Highway will ever be the best way of getting from New York to the Raritan River.

After bad pavement, the motorist's outstanding dread is the detour sign. Here again I am prepared to be reasonable. Roads wear out and have to be rebuilt, new knowledge makes it desirable to put down a type of roadbed that is less amenable than the old to construction without interrupting traffic. Few roads are wide enough to permit the contractor to establish himself on one side and leave the other open, with or without a flagman according to the length of the single-*track stretch. And the very fact that the road affected* is the main line means that any route selected for the detour will be inferior.

All this is admitted. But during the early part of the last summer there was a detour out of Gettysburg

on the Lincoln Highway seventy miles in length, over mountain roads built for the one-horse shay and never reconstructed. I drove into Mansfield, Ohio, from the east over bad dirt roads for forty miles—parallel with the Highway all the way and never more than two or three miles from it. I encountered a similar 30-mile detour into Erie from the west. It is respectfully submitted that there never was and never will be any justification for atrocities of this sort.

There is doubtless a certain amount of convenience to contractors and county authorities in closing, once for all, the entire length of road upon which operations are to be conducted during the current season. One can even imagine circumstances under which it might be similarly convenient to carry on work at several isolated points, so distributed along the road as to close a stretch of many miles. But the convenience of county authorities and of contractors is not the only factor that ought to be considered; the convenience of those who are trying to use the roads should be weighed for what it is worth. The loss to truck and car owners through an unreasonable detour may far exceed the loss which would accrue to contractor and to the county



1. Typical fill on permanent grading in Crawford Co., Ia. 2. Laying monolithic brick east of Bucyrus, O.; work responsible for one of the detours to which the author was subjected. 3. One of the fine new stretches of concrete Lincoln Highway in Indiana. The view might equally well have been taken in eastern Pennsylvania or between New Brunswick and Princeton, N. J. 4. Building the permanent Lincoln Way in Linn Co., Ia. 5. The old and the new of Lincoln Highway bridge construction. In addition to the obvious difference, the elevation of the new crossing eliminates heavy grades leading to the bridge at either end. Many of Ohio's streams lie in deep gullies, and are bridged at the level of the stream instead of that of the surrounding country; but new construction is gradually remedying this

Typical examples of the sort of engineering work that is going into the 1921 sections of the Lincoln Highway

treasury through a more rational distribution of the work. I cannot imagine conditions under which it would not be feasible to confine operations to a comparatively short stretch of the road at a time, concentrating a larger number of men on this stretch if this were desirable, so that at no time would it be necessary to close more than five or at the outside ten miles of the main road. In the presence of parallel roads—they are universally present in Ohio—this could not lead to detours of more than fifteen miles. In their absence, and under the greatest misfortune in the matter of intersecting roads, it should not in a settled country like Pennsylvania lead to a circuit of more than twenty-five miles; seldom to one so long. Incidentally, I should like to call Ohio's attention to the custom in New Jersey, where the rebuilding of a bridge is ordinarily preceded by the construction of a temporary crossing alongside the permanent site, before the old structure is demolished. This practice removes the last excuse for long detours.

A word of caution, however, may be inserted here, drawn from my observations of the detour that has existed between Trenton and Philadelphia during the past season. In this instance an effort was made to follow the procedure which I have outlined, confining the work to reasonable stretches of road at a given time and making the detour only long enough to circumnavigate the parts affected. I have been over this route several times during the past season, and have not found this detour any two times in the same place. This is fine; but it is rather discouraging to discover, after following it in its latest location for five miles, that the gentleman in charge of the relocation of the signs has got tired of his job, and after getting one nicely on to the thoroughly dilapidated Bristol road has left one to blunder into Philadelphia by the side door or to wander back to the Highway at an indeterminate point as one best could. It doesn't do to shift the detour without shifting the signs. Whatever I might have had to say about detour signs *per se* is said by a contributor on another page.

There are certain radical differences between different sections of the country which come strongly to the attention of the visiting motorist. Here in the east we do not expect our roads to be straight, just so they ultimately arrive at the point to which they are supposed to go. We run them around swamps, hills, hillocks—the most trivial of obstacles, in fact. Throughout the middle west, with trifling exceptions, the roads run straight east-west and north-south, with at most a little jog here and there to effect a more favorable crossing of a stream. This makes it impossible to get seriously lost. One has only to count the turns to be absolutely certain of one's direction. And one has but to watch the telephone wires to know whether one is approaching or receding from a town. If they thin out as you run past the widely spread houses you are leaving a town behind you. When they disappear altogether you are crossing the no-man's land between the districts served by two consecutive towns. When you finally pass a house again and begin to pick up the poles with their wires, you are certain that you are approaching civilization once more. It may not be the town you want; if it is not, the worst thing possible is that you will have to turn north or south to that town. Getting completely off one's course and at loss for one's direction or location is out of the question. But the Ohio and Indiana drivers must have a tough time till they get used to the erratic behavior of the eastern roads.

The easterner who goes through the middle west and gets off the really big routes of travel, however, has one unpleasant surprise in store for him when he asks the way. The answer will invariably be "Keep right on the Pike; don't turn off." And within the next ten miles there will be anything from five to twenty places where there is a fork, both branches of which look exactly alike to the untutored eye. *The native labors* in the firm conviction that the "Pike" is stone and the other roads dirt; but if there is a distinction it is not visible to the eastern eye. I suffered from this more than anywhere else along the Colerain Pike, which runs across the Ohio hills from Wheeling to the Canton and Cleveland district, connecting there with the Lincoln Highway. As one goes west the rectangular system of laying down the roads of course abates this nuisance considerably. A crossroads is not half as puzzling as a fork.

Another curious departure is found in the matter of the treatment of the garage help. My eastern readers would know better than to come back to a garage where they had taken on air or water without crossing the attendant's palm with silver. They would know what reception to expect if they drove up to a strange garage and helped themselves to these commodities. In the central states you are always expected to help yourself.

The very air stand is out on the curb and there is no control cock that has to be opened indoors. I had to apologize to a garage hand in Wooster, O., to whom I innocently and as a matter of course offered a quarter after serving myself from his hydrant and air stand. They do not even charge or expect a tip, for distilled water for your battery, as I learned to my further humiliation in Mansfield. And if there is anything to be done on the internals of your car they are glad to have you hang around and watch them take it apart, offer advice and pump them for information, help them with recalcitrant bolts or other two-man jobs, and generally conduct yourself as though you were one of the firm. The man from Ohio or Indiana will have to tour the New York district before he can realize what a jolt all this is to the easterner.

The Lincoln Highway has been advertised until the average man has the impression that with the exception of a few final touches here and there it is prac-

Left: Columbiana Co., Ohio, had 27 miles of this sort of thing. *Right:* This view, taken at another point near the Pennsylvania line, is representative of the kind of road that has replaced the muddy wagon trail of previous years.

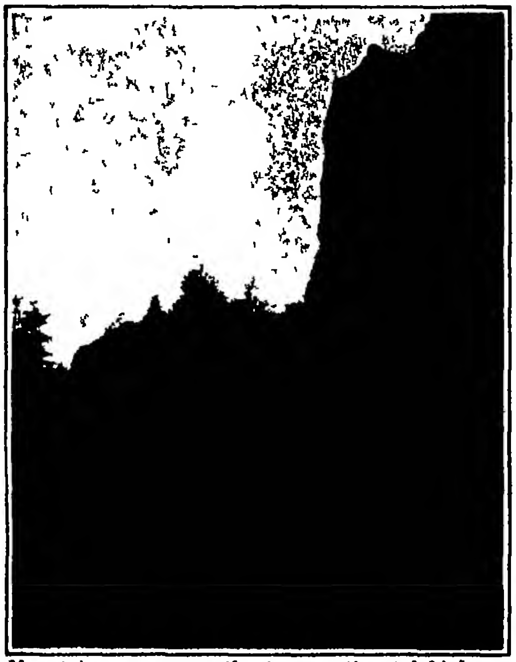
Ohio roads before and after the 1921 campaign on the Lincoln route

tically finished and ready for use. I was the average man, I supposed that I could follow the pretty red-white-and-blue markers clear to Chicago just as easily as I could follow them to Princeton, with no more serious obstacles than an occasional detour, and perhaps a few miles of inferior road here and there.

From New York to Gettysburg and from Lima to Chicago this expectation was borne out by the facts. In the region between Gettysburg and Lima—well, it wasn't. My advice to motorists for 1922 is emphatic. Stay off this part of the Lincoln Highway until some one who loves you has been over it, and assures you that it is in shape to travel on. When it is finished, so far as one can judge from what is being done to it in Pennsylvania and Ohio, the enthusiastic forecasts of a concrete thoroughfare from New York to Chicago will be abundantly realized. Till then it is no place for anybody to go in an automobile.

Between Gettysburg and Pittsburg the objection to the Highway in its present state is simple. Parts of the route have been concreted, in accordance with the program of the Pennsylvania Highway Commission. With respect to the other parts concreting is a matter of the future. It will presumably be done in the near future and there is no particular reason to suppose that the detour issue will be handled any more intelligently than it was in 1921. Until these links are concreted it is no kind of fun travelling them.

West of Pittsburg the situation is in general terms the same, but in its details it is far more annoying—at least, it was during 1921. In the first place, there isn't a single Lincoln Highway through Ohio. There are three or four places where the Highway has been or might have been or could be or where somebody wishes that it were; and all of these are marked with red-white-and-blue stripes of one design or another. You can't cut the Gordian knot by following the latest style of marker, because for about 100 miles between Massillon and Upper Sandusky this would take you along a route that is barred by detour signs for practically its entire length. Of course I am here speaking of 1921 experience. I was on the Highway just four times over this stretch—in passing through Wooster, Mansfield, Galion and Bucyrus. The city limits invariably produced a detour that lasted till we were approaching the next city. Moreover, in at least one case the Association has allowed itself to be cajoled into marking two alternative routes with the latest model of 1921 standard markers.



Mountain scenery on the transcontinental highway through Wyoming

The forty mile stretch immediately east of Mansfield was a nightmare. Plainly marked detours led to bridgeless bridges, detour signs ran out and left one to run for ten miles without guidance, one detour led along a concrete road in process of construction, on which the west bound car had to run off a four inch curb on to a most disreputable old wagon track to let eastbound cars pass, and in general, everything that road construction can bring out to plague the passing motorist was brought out to its full degree of possibility. I am informed that in the neighborhood of the Ohio-Pennsylvania line there is another gap of some miles of the same general character, with the exception that the detours are even worse.

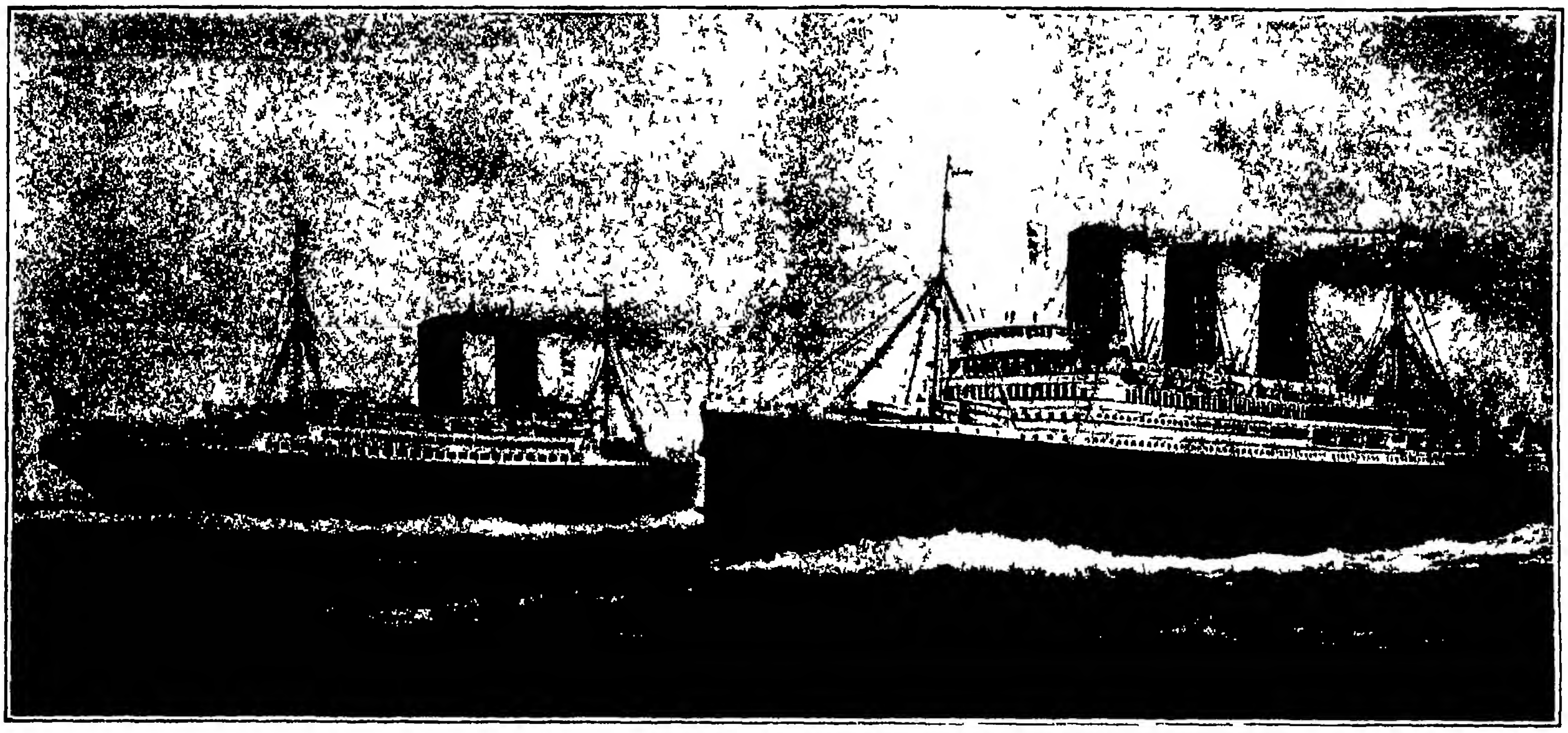
The impression that I got in running through this barricade was that the route could not possibly be got into shape by the end of the season of 1921. So I repeat, when the Lincoln Highway is finished it will be thoroughly good, but until you are assured by something more substantial than statements of the amount of money so far spent, you will best assume that it isn't finished, and aid in its ultimate completion by staying off it.

This leaves the question open of how to get across the country in an automobile. There are two ways, either of which, during 1921, was vastly to be preferred to the Lincoln Highway, and both of which lend the strong suggestion that their superiority will be more pronounced in 1922. The first involves using the Lincoln route as far as it is good—which is to say east of Gettysburg and west of Lima. If it is more convenient to pick up the northern loop of the Lincoln way (which leads here a double life), this can well be done at Upper Sandusky or any point west thereof, or perhaps as far east as Bucyrus. Between Gettysburg and the point where the main line is rejoined in Ohio, the old National Highway offers a route to which the most captious critic could offer no serious objection.

Through Maryland this route merits the adjective "superb." Superb in the condition of the road, clear through from Gettysburg via Waynesboro, Hagerstown, Cumberland, Uniontown, Washington (Pa.) to the West Virginia line, where twelve miles of bad road separate one from Wheeling; superb in its historic associations and its scenic attractions; and superb in its mountain-climbing features. In this connection the motorist ought to be warned not to leave Hancock bound west or Uniontown for the east with any little thing the matter with his car. These are real mountains, with long winding grades of 8 and 10 per cent, which compel the largest and most powerful cars to run largely in first speed and to stop half way up the longer pulls, to cool off and to permit the youth of the country to fill the radiators at 10 cents per fill. The highest elevation attained is Negro Mountain, a few miles west of Grantsville, Md., 2,006 feet. The longest severe climb is three miles up Chestnut Ridge going east out of Uniontown, but going west, the road rises continually from Cumberland, 685 feet, to a point beyond Frostburg, 2300 feet. Nor is Cumberland the beginning, it is reached from the east only by severe climbs over at least two ridges, and less serious grades in profusion. And there are many double and triple curves of extreme sharpness. But the uniformly fine character of the road makes the trip a pleasure to anyone who is able to feel confidence in his car.

(Concluded on page 80)

Another scenic feature of the coast-to-coast tour; a point in Pennsylvania where several miles of the Highway is visible winding among the hills ahead



Left Homeric", 775½ ft. by 83 ft. is an improved George Washington *Right* Majestic, 983½ ft. by 100 ft. is an improved Leviathan

Two great passenger ships, now completing in Germany for the White Star Line

The "Big Five"

Our Bid for the Transatlantic Passenger Trade

IF you should drop into the headquarters of the Shipping Board in New York seeking information, or on a business call, you would probably hear more than once the phrase, "The big five" It is the Shipping Board's generic term for the largest and choicest of the transatlantic passenger steamers which were shut up in American ports and held there by the blockading force of British cruisers outside, and upon our entrance into the war were seized by the United States Government. After the Armistice we obtained permanent possession of these ships, which form the leading members of a fleet whose total tonnage amounted to some 600,000 tons.

Although it is an old story, we cannot forbear making reference just here to the very able work which was done by our Navy Department in repairing the wreckage which had been wrought upon the engines of most of these ships by their German officers, just prior to our entrance into the war Steam cylinders and steam-chests, from which the Germans had smashed large fragments, were repaired by electrically welding new sections in place and reboring and refacing them The repairs were so efficient that we were able to put the whole of the fleet, or as much of it as we wished, into our transport service, and the vessels did yeoman work in carrying our Army across the Atlantic

After the Armistice the various transports, or most of them, were tied up to different docks until the Shipping Board was able to overhaul the engines and restore the interior passenger accommodations. Much of this work has been done, and some of the largest of the ships are today in operation Upon others, the work of reconditioning involves so much expense that it has not yet even been commenced Conspicuous, of course, among these is that great ship, the 'Leviathan." In the order of their size and importance, the "big five' are the "Leviathan," the "George Washington," the "America" the "Agamemnon," and the "Mount Vernon And for the particulars of these vessels, reference is made to the accompanying table.

The "Leviathan"

With the single exception of the "Majestic," which has been assigned by the Shipping Board to the International Merchant Marine for operation, the Leviathan' is the largest ship afloat, the "Majestic' (ex Bismarck') is six feet longer These two liners were built side by side upon the building way of the firm of Blohm and Voss at their celebrated Hamburg yard from the designs of Dr Foerster the chief naval architect of the Hamburg-American Company for whom the ships were constructed The "Leviathan' then the "Vaterland," made her maiden trip to New York in the early summer of 1914, and after two or three voyages, the war found her at the Hamburg-American dock at Hoboken, where she remained until the Spring of 1917 The "Leviathan' is 927½ feet long on deck her beam is 100 feet, and her molded depth is 57 1 feet The gross tonnage is 54 282 tons, and the four turbines of 90 000 horsepower, driving four shafts, were designed to give her a speed of 23 knots, which she is able to make today

The ship was most sumptuously furnished and decorated in the German style, the special features being a large assembly room about 75 x 55 feet and about 25 feet high, which is entirely free from supporting columns, the great roof being carried by overhead plate girders, extending from side wall to side wall Another remarkable feature is the Ritz-Carlton restaurant of about equal width and height and about 55 feet wide There is also a main dining room which measures about 115 feet by nearly 100 feet Below decks is a Pompeiian swimming pool and a series of electric baths, massage rooms and other equipment of the same character

In preparing the ship for transport service a large number of her elaborate private cabins were torn out to make way for pipe berths for the men and so far as her decorations were concerned she was subjected to that all around wrecking which is involved in turning a passenger vessel of this kind into a transport

Particulars of the Shipping Board's "Big Five"

	Leviathan (Ex-Vaterland)	Geo. Washington	America (Ex Amerika)	Agamemnon (Ex-Kaiser Wilhelm II)	Mount Vernon Ex Kronprinzessin Cecilie
Length of deck, feet	927½	699	669	684¼	685¼
Beam, Feet	100	78	74	72¼	72¼
Depth, feet	57 1	50 1	47	40	40 5
Gross tons	54,282	23,788	21,144	19,380	19 503
Speed, knots	23	17	16	23	19
Passengers, first		485	450	600	600
Passengers, second		440	250	420	301
Passengers, third		1,771	1,500	603	657
Total		2,696	2,200	1,583	1 558

Leading particulars of the five large passenger ships with which the United States Shipping Board will compete for the transatlantic passenger trade

The 'Leviathan" Well Cared For

Contrary to the popular impression, which has been created by irresponsible newspaper reporters the Leviathan has been very well cared for during the three years in which she has lain at the Hoboken docks A force of some 200 men has kept the machinery, including the main engines auxiliary pumps, et cetera in first class condition They have been periodically inspected, turned over and protected against deterioration and, thanks to the excellence of this care, the ship at a few hours notice would be able to steam out of her dock and make her maximum speed of 23 knots Also, the talk about this valuable ship rusting at her moorings is sheer nonsense She has been cared for by the International Merchant Marine under a contract with the Shipping Board and the patches of red lead paint with which she is disfigured are evidence of the fact that rusting is just the one thing against which the caretaking crew are guarding The hull is in fine condition for the ship was built of the best materials and with the careful workmanship which characterizes the best German shipbuilding yards

At the same time it must be confessed that the Leviathan is something of a "white elephant ' for it would take between six and seven million dollars to reconstruct the interior passenger accommodations of the ship and refit her to meet American ideas of comfort, decoration and sanitary arrangements The work would be enormous, involving the construction of many miles of electric cables, the complete overhauling of her

baths and sanitary and general plumbing arrangements, and the redecoration of her great assembly and dining halls and the vast suite of private cabins. She stands as a monument to the folly of the Shipping Board during the early part of its administration, for it is a fact that the International Merchant Marine Company made a bid of four million dollars for this ship—a reasonable offer if we bear in mind the enormous cost of her reconditioning. This was turned down, and Heaven alone knows what will become of the ship! Any firm that bought her would have to spend six or seven million dollars upon her and would be hard put to it, even with full cabins, to get any profits out of the venture

The "George Washington"

The next largest ship, the well known "George Washington," in which the President of the United States so frequently crossed to France during the peace negotiations, has been entirely renovated and is now in service. The engines and general mechanical plant are in first class condition, and she has been entirely rebuilt and redecorated throughout This ship belongs in that class which used to be called "intermediate express steamers," in which a large freight-carrying capacity is combined with commodious passenger accommodations. The "George Washington," according to the American register of ships, is exactly 690 feet in length, her beam is 78.2 feet, and her molded depth, 50.1 feet Her gross tonnage is 23,788 tons, and her engines of 20,000 horsepower, drive the ship at a sustained sea speed of 17 knots. She has accommodations for 485 first-class, 440 second-class and 1,771 third-class passengers—a total of 2,696 The cost of renovating the interior of the ship was $2,000,000

The "America"

Another fine vessel of the same class, built by Harland and Wolff, of Belfast, but older than the "George Washington," is the "America" Her dimensions are Length of deck, 669 feet, beam 74 feet, molded depth, 47 feet Her gross tonnage is 21,144 tons, and she is capable of a sustained sea speed of 16 knots She can carry 450 first-class, 250 second-class and 1 500 third-class passengers. The engines of the "America" have been partially rebuilt and subjected to a thorough overhauling, and today are in excellent shape Passenger accommodations have been entirely rebuilt and redecorated, and this part of the work is attractive, highly artistic and very restful to the eye.

The "Mount Vernon" and "Agamemnon"

These two ships, built for the North German Lloyd Line, in their day held the blue ribbon of the Atlantic conjointly with the "Deutschland" of the Hamburg-American Line. They are practically sister vessels, and under the German flag they were known as the "Kaiser Wilhelm II" and the "Kronprinzessin Cecilie." "Kaiser Wilhelm II" equalled the record speed of 23 1-3 knots made by the "Deutschland" for the whole crossing of the Atlantic, and both ships were exceedingly popular in their day After they came into the possession of the Shipping Board they were overhauled The work on the "Mount Vernon" (formerly the "Cecilie") was done at the Boston Navy, where the engines were overhauled from the engine foundations up, they are now in first-class running order Work on the "Agamemnon" was done at the New York Navy Yard Renovation of the cabins accommodations in these two vessels is not yet complete, but we understand it is to be put through by firms acting under contract with the Shipping Board. The dimensions of the "Agamemnon" are length 684.3 feet, beam, 72 3 feet, depth, 40 feet, gross tonnage, 19,360 tons, and the engines today are capable of driving her at a speed of 23 knots. She has accommodations for 600 first-class, 320 second-class, and 663 third-class passengers

The five ships mentioned above, with the exception of the "Leviathan," have been operated under contract with the Shipping Board by the lately defunct United States Mail Service. At present they are being operated by a company of patriotic officials, who are giving their services for nothing, the company receiving a certain sum from the Shipping Board to cover the expenses of running the ships.

The "Majestic" and "Homeric" of the White Star Line

When the war broke out, the "Bismarck," sister-ship to the "Leviathan," then known as the "Vaterland," was under construction at the Blohm and Voss yards at Hamburg. Little was done upon her during the war, but since the Treaty representatives of the White Star Line and of the German builders are working together to outfit her with stores and minor equipment She will be operated for the Shipping Board who will pay the company a certain sum for that service. On taking her place in the New York-Cherbourg-Southampton service, she will conform in the details of her passenger fittings to the standards of the "Olympic," with which she will ply in that service. She is about 10,000 tons larger than the "Olympic," and about 2,000 tons larger than the "Leviathan," or 56,000 tons. The increase in size is due to the fact that after she was designed, it was determined to introduce two additional frames amidship, giving her an increased length of six feet, so that, according to the American Maritime Register, her length on deck will be 955.6 feet. This great ship will have 1,245 staterooms, including 472 first-class, 212 second-class and 561 third-class cabins. The dimensions of the vessel are enormous. The tops of the three smokestacks are 144 feet above the water line of the ship and 184 feet above the keel, which is about equal to the height of an ordinary 14-story building. There is a great suite of halls on the boat deck, including a lounge 26 feet high, with floor dimensions 76 by 64 feet. The main dining room is 117 feet long by 98 feet wide, and its ceiling is 81 feet high. The first-class restaurant is 110 feet long by 54 feet wide, with a ceiling 23 feet high. There is an unbroken view through the center of these halls of 250 feet. This is made possible by the arrangement of the uptakes to the smokestacks, which are brought up, from the boiler rooms, near the sides of the ship in two parts which unite above the saloon deck The grand staircases are also built on the sides instead of in the center of the vessel These arrangements insure a clear sweep of unimpeded space throughout the great public rooms. The estimated sea speed of the ship is about 23 knots, though it is probable that, in common with all big, fast passenger steamers today, she will be run at a lower speed than that in order to economize fuel Including her crew of over 1000 men, the full complement of the ship will be more than 5000 souls.

Another fine ship that will be operated by the International Merchant Marine is the "Homeric" (formerly the "Columbus"), which was practically completed for the North German Lloyd Line at the outbreak of the war She was designed to be an improvement on the "George Washington," which she resembles in general appearance She is 775 6 feet long, her beam is 83.1 feet and draft 33.8 feet The gross tonnage is 32,000.

The Chemistry of the Volatile

Some Interesting Facts About a Relatively Obscure Phase of Chemistry

By Dr. Alfred Gradenwitz

WHILE carbon with its inexhaustible wealth of compounds constitutes the basis of organic life, two other elements, boron and silicium its immediate neighbors in the Periodic System, so far exhibited a paradoxical behavior by the extremely limited number of reactions they seemed to be capable of Just imagine the enormous number of about two hundred thousand carbon compounds, natural or artificial, and on the other hand in Nature, nothing but the rigid, mineral boric and silicic acids, and in the laboratory, a trifling number of compounds almost without an exception showing no analogy with those of carbon

The admirable researches carried out of recent years at the Kaiser Wilhelm Institute of Chemistry (Dahlem near Berlin) by Prof Alfred Stock, in conjunction with Dr Kuss and other fellow workers, have changed all this by the discovery of a wonderful variety of compounds showing a close analogy with those of organic chemistry, the apparent inertia of boron and silicium being due to the extremely volatile and ephemerous nature of most of these compounds

These somewhat unexpected results were reached by a special and most refined method of experimenting, which enables such volatile substances in minimal quantities (some tenths of a gram) to be handled, cleansed, analysed, their physical constants to be ascertained, and their chemical behavior to be studied under perfect seclusion of any air, fat or moisture

Experiments are carried out in a high vacuum, in glass tube outfits having all their parts joined by blowing, while the ordinary fat tightened taps are replaced by a special type of mercury valve. These glass tube systems, combined in accordance with the requirements of each case, comprise amongst other things High speed air pumps for exhausting, self-acting mercury air pumps for the collecting of gases, different types of vessels for performing reactions and analyses, separating mixtures (by fractionated distillation or condensation), determining melting points and densities of gases and liquids, storing gaseous and liquid products, manometers and checking barometers, arrangements for weighing these substances, heating them, introducing them into closed tubes and back again into the glass tube outfit, etc. All these operations are carried out without the substances ever coming into contact with air These volatile substances can within the glass tube outfit be transferred to any place previously cooled with liquid air, a few seconds being sufficient for them to be condensed entirely Liquid cooling baths or metal blocks cooled with liquid air are used to produce the temperatures required in the various parts of the outfit for fractionated distillation or the like, while a determination of gas tension, carried out with the simplest possible means and without any loss of substance, serves to test the purity of and to identify these volatile substances. The strictest care is taken to insure absolute purity of the original substances used for reaction, the use of dissolvents being avoided as far as possible, while any materials subject to decomposition are for further treatment permanently stored in liquid air

While this vacuum process is rather exacting with regard to space, time and expenditure and requires a special technique only to be mastered by experienced workers, the outfit, once installed, will enable minute amounts of material to be utilized with surprising economy The process will supply the most accurate data as to the purity of substances, the composition of mixtures, the mechanism of reactions. When striking the balance of a completed series of tests, all the components of the original materials will be found back again in the terminal productions to within fractions of a milligram Prof. Stock does not hesitate to affirm that whoever once has become familiar with the new method will even prefer it in cases where larger amounts of material might as well have been treated according to classical chemical methods.

The new method greatly extends the limits of accuracy in connection with chemical synthesis and analysis. Wherever Stock and his assistants with its aid checked existing physical data, as recorded in literature (melting points and tensions), the material used in connection with previous tests was found not to have been sufficiently pure. In fact, many problems on which much time and thought have been bestowed could be settled immediately by means of the vacuum process.

The remarkable results of these investigations enable the special chemical relationship between carbon and its closest neighbors in the periodical system, boron, silicium and nitrogen, to be ascertained in all details. The *individual* chemical faculties of each of these three elements are, as Stock puts it, "in the case of carbon *combined* in a maximum of perfection and harmony"

In the case of boron and silicium there is a prevailing affinity for oxygen, in that of nitrogen a prevailing hydrogen affinity With carbon, there is about equality of hydrogen and oxygen affinities, its power of binding hydrogen and oxygen simultaneously in variable proportions and forms being of the highest importance for the organic world. With nitrogen, carbon shares the volatility of natural simple compounds. The same as ammonia in the case of nitrogen, carbon dioxide in the case of carbon is the cause of permanent chemical cycle. After its migrations through vegetable, animal and human organisms, carbon will over and over again manifest itself in the form of carbon dioxide, penetrating in this volatile form wherever new chemical reactions are waiting for it.

Boron and carbon show a close analogy in their power of aggregating large numbers of their own atoms into stable molecular complexes, "chains", "rings", etc. Like silicium, carbon possesses the faculty of polymerizing small molecules into large non-volatile ones.

This much can be asserted on the strength of Stock's experiments, that the chemical character of carbon is only quantitatively, not in principle, different from that of other elements.

Naval Strength of United States, Great Britain and Japan

How Age of Ships Will Affect Relative Fighting Efficiency by 1924

By J Bernard Walker

ALL comparisons of the relative strength and efficiency of warships are more or less unsatisfactory. One ship may have high speed and great gunpower, but be weak in armor and underwater subdivision, another will sacrifice speed to gunpower and armor; and yet another will have abnormally high speed, combined with light armor, moderate gunpower, and fairly good subdivision.

In the presence of this bewilderment, naval writers, both inside the Navy and out, have developed various ingenious schemes for allotting certain index values to the separate elements of warship efficiency, and thereby reaching a final number which represents to what degree a given vessel is 100 per cent efficient This system is tedious and arbitrary, for there is no general agreement as to the relative values of guns, armor, underwater subdivision and speed

The SCIENTIFIC AMERICAN has long held the opinion that the only single basis of comparison of the fighting one, the displacement, which, *at the date of a ship's completion only*, has a clearly defined value

Displacement Value As Modified by a Ship's Age

In an article published in the SCIENTIFIC AMERICAN of February 12, 1921, we compared, upon a straight displacement basis, the relative strength of the three leading navies as they stood on that date and as they will stand in 1924 This comparison shows that if the nations concerned complete their shipbuilding programs the United States will lead, with Great Britain second and Japan third

Now, although that comparison on the basis of mere displacement is accurate so far as it goes, it does not go far enough, inasmuch as it does not give us a true picture of the relative *military* efficiency of the three navies. There was left out of the comparison an element which is more potent, far more potent, in determining the value of ships that are armor, guns subdivision and speed *We refer to the question of age, and the undisputed fact that, from the day a warship takes the water, there sets in a steady and very swift depreciation of her military efficiency* It follows, therefore, that when you have completed your calculations of the fighting efficiency of two ships, on a basis of displacement, you are still very far from a final and accurate conclusion. That can be arrived at only when certain deductions have been made from her efficiency, proportionate to the years which have elapsed since she was completed.

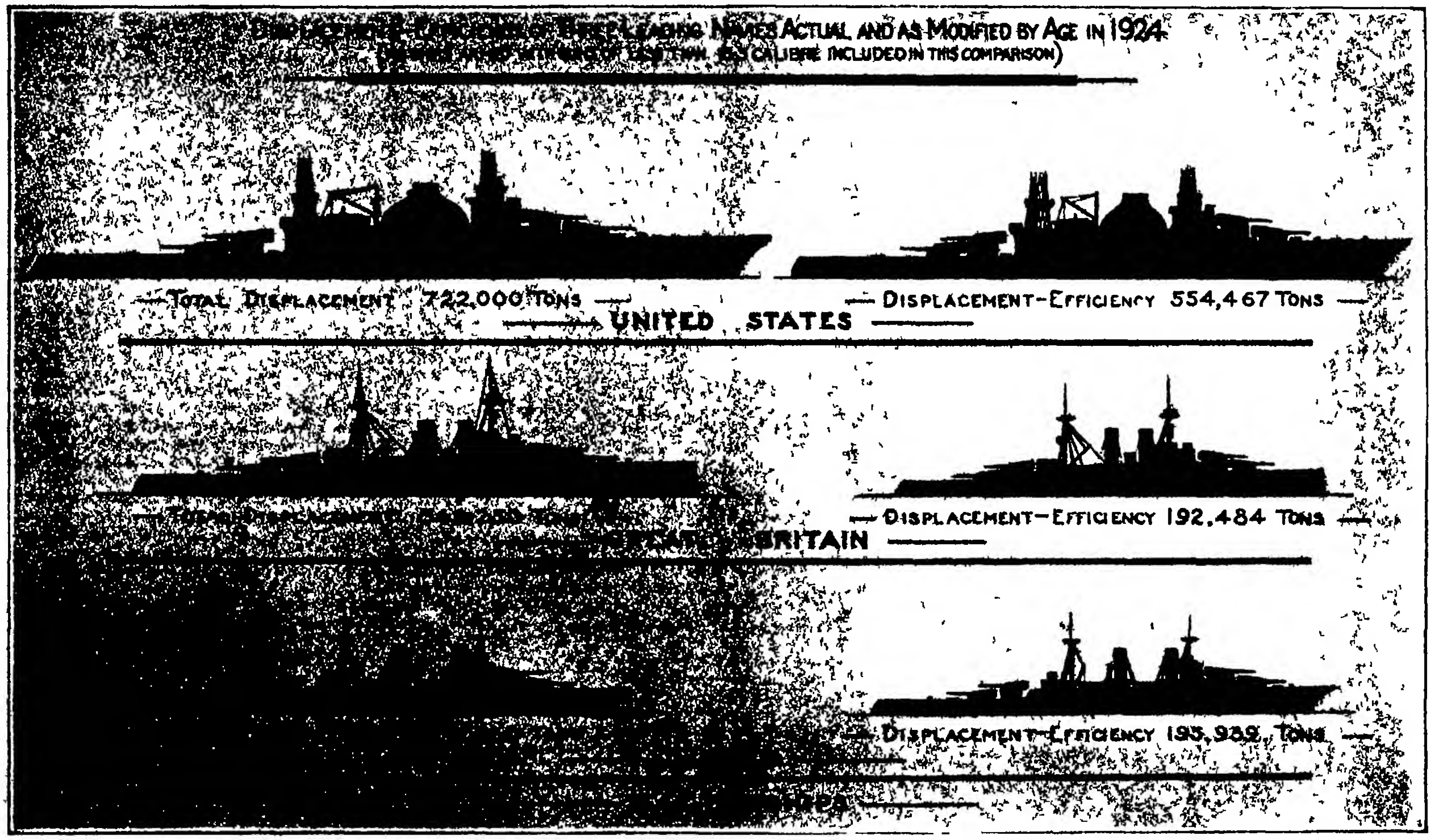
Capital Ships Obsolete in Fifteen Years

Every owner knows that an automobile depreciates, steadily, from the day on which it is bought, but not many people outside of the Navy realize how short is the effective life of a warship—how rapidly she slides down the scale of efficiency and reaches a period when she must be written off the naval lists as obsolete

Just here it should be made clear that this does not mean that warships, any more than automobiles, are poorly built, or that inferior materials enter into their construction Quite the contrary No fabric that floats upon the high seas embodies within it such skilled design, such carefully selected materials as a modern warship More than that, there are no vessels not even the finest in the mercantile marine, that receive such careful upkeep or have such great sums for refitting expended upon them at regularly recurring periods as a warship

Warship Depreciation Due to New Inventions

The rapid aging of the battleship and battlecruiser is due not to material but to military depreciation, and military depreciation is due in large measure to naval invention Naval invention, coupled with the skill of the naval constructor, is carrying the progress of the naval art along so rapidly that, after ten years of service in the first battle line, a capital ship must be relegated to the second line, and in fifteen years is ready for the scrap heap Furthermore, development seems to proceed not upon arithmetical but upon geometrical lines, with the result that the more modern the ship the shorter is her tenure of useful military life



Drawings at left: Comparison by displacement. *At right:* Comparison by displacement as depreciated by age

Comparison of battleship strength in 1924

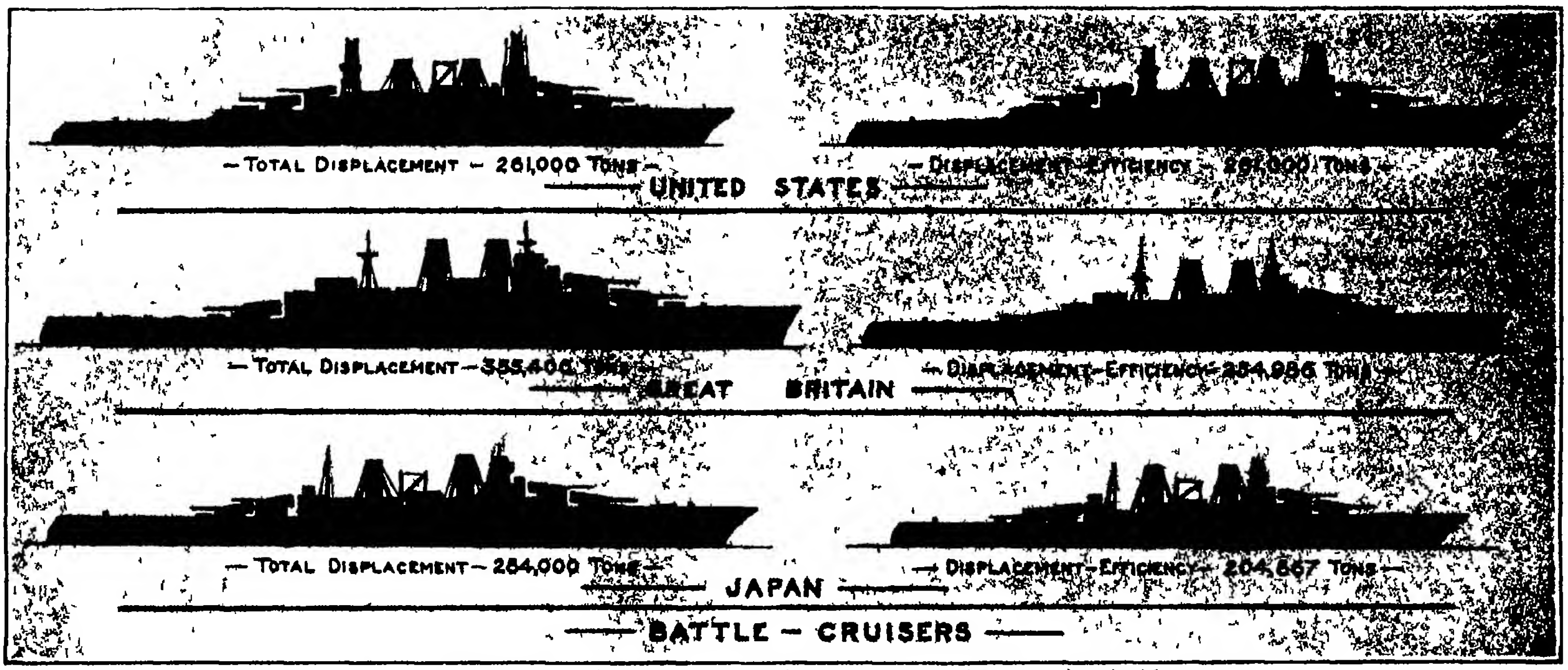
value of two ships that comes pretty close to the truth is that of displacement. The naval designer may add good quality to good quality in building up his plan, but he can never afford to forget that he has to float this aggregation upon the high seas, and flotation means displacement, and displacement is determined for him mainly by the depth of the national purse.

Displacement As Basis of Comparison

In the earlier years of the development of steel navies, there was a much greater diversity in warship design than there is today Naval construction was feeling its way. The art is now so highly developed, the principles so well established, and designers in the leading naval countries are so closely in touch with one another, that it is safe to say that a thousand tons of displacement has a fairly constant value, whether it be in a Japanese, British or United States ship. Furthermore, of all the elements included in those detailed analyses of ships to which we have referred above, there is just

Age Depreciation and Rising Cost of Navies

This rapid military depreciation of ships due to unforeseen inventions, for which, in the nature of things, no provision can be made in the ship at the time of her construction, is a fruitful cause of the continual increase in naval budgets, to replace ships that age has eliminated To this must be added the rapid increase in the size of ships, to say nothing of the growing costs of labor and material It is the realization of these *facts that is responsible, in no little degree, for the* growing reluctance of the taxpayer to put his money into such mastodon warships as the "Indiana", the "Hood" and the Japanese "Amagi" The man on the street realizes that competition in building must cease



Drawings at left Comparison by displacement. *At right:* Comparison by displacement as depreciated by age

Comparison of battle cruiser strength in 1924

or the nations will be confronted with bankruptcy Competition in armaments has reached a veritable *reductio ad absurdum*

The Logic of Our Tabular Comparisons

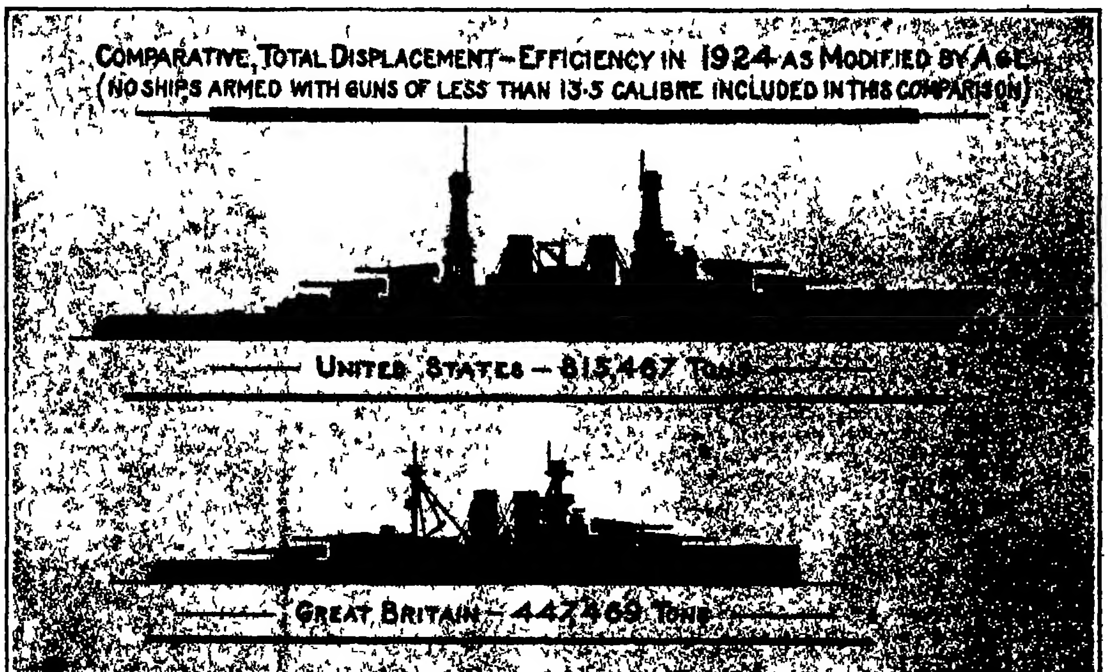
To test out the influence of age upon efficiency and get some exact figures, the writer recently drew up the accompanying tables, showing the actual age of existing battleships and battlecruisers by the year 1924, and the result was so interesting that the tables are here presented in detail The method of comparison is based upon the fact that a battleship is obsolete in fifteen years, if not, indeed, sooner Proof of this is seen in the fact that the eight capital ships which Great Britain recently announced in Parliament she had decided to send to the scrap heap were from thirteen to fifteen years old with an average age of 13½ years They were eliminated because their 12 inch guns were too feeble to be opposed to the 14 and 16-inch guns of modern ships, their underwater subdivision inefficient against the modern mine and torpedo, and their armor insufficient

If a capital ship is worthless for active service in fifteen years—that is to say, if she is at 100 per cent efficiency on the date of her completion and has zero per cent of efficiency in fifteen years, we take it that a reasonable way to get at her efficiency at any period in the interim is to find out how many years of life are still left to her Thus, a ship five years old will be two-thirds efficient a ship ten years old one-third efficient, and so on

It should be noted that the date of completion of the newest ships in these tables is assumed In the case of our ships of the "Indiana" class, it is based on their present degree of completion, which renders it unlikely that any of them will be in commission before 1924 The four vessels of the "Maryland" class, by 1924 will have spent one to three years of their life Even the flagship "Pennsylvania" will have consumed eight years of her life, and therefore will have but seven fifteenths of her original efficiency, while the "Delaware and "North Dakota," our earliest dreadnaughts and once the pride of our Navy, will be 14 years old and but one-fifteenth efficient In all probability we shall do as the British have done, and condemn, before 1924, the six vessels of the "Arkansas", "Utah" and "Delaware" classes, since all of these carry only a 12-inch gun Therefore we have not included them in the total of 21 battleships which we shall have on that date The grand total of what we might call the efficiency-displacement as reduced by age, for our battleship fleet, will be 554,467 tons. Our six great battlecruisers, being brand new like the six "Indianas," will have their full displacement value of 261,000 tons, making a grand total for the United States of 815,467 tons efficiency in capital ships.

The British fleet totals, as given in our article of February 12, 1921, have been modified by omitting the capital ships that have been ordered scrapped since that article was written, and by including the four new battlecruisers whose construction is soon to be commenced These vessels will resemble the "Hood" They will have less speed but greater gunpower than that ship, and they will embody such lessons of Jutland and of post war experience and investigation as have not been included in the "Hood" These elements will include the usual bulge protection against mines and torpedoes, and an armament of 16-inch guns mounted in triple turrets (not 18-inch guns, as so often reported.) Particular attention will be paid to horizontal armor The speed will probably be about 28 knots as compared with the 31½ knots of the "Hood", and it is likely that their displacement will be about the same as, or a little more than, that of our "Indiana." Consequently, we have put them down at 45,000 tons each, and as they should be just about completed in 1924, they are included at full displacement-efficiency value among the British battlecruisers.

By the time the contracts for the four capital ships are let, Great Britain will have done no new warship construction for three years, during which time her existing fleet has experienced three full years of depreciation. The consequence of this is shown very forcefully in the total displacement as modified by age, which drops from 548,250 tons to 192,484 tons. Had it not been decided to scrap the six battleships armed with the 12-inch gun, their age-displacement value would have been so low, that it would have added less than 15,000 tons to the total Similarly, among the battlecruisers, even



Relative fighting efficiency in capital ships by close of 1924

the "Hood" will have lost four years of her usefulness by 1924. The two fine ships "Repulse" and "Renown" will have lost eight years; the "Tiger," with ten years gone, will have only one-third efficiency. The "New Zealand" and "Australia", carrying 12-inch guns will have been eliminated; so that the grand total of battle-cruiser efficiency will be 254,986 tons.

In the Japanese tables are included four battlecruisers of the "Amagi" and "Atago" classes, and the sister battleships, "Kaga" and "Tosa." Four of these vessels, all of over 40,000 tons displacement, will carry practically their full efficiency value in 1924. The battleship "Settsu", a 12-inch gun ship, has been omitted from our list.

All Nations Must Slow Down, or None

These comparative tables, showing the effect of age on efficiency, teach most eloquently the lesson that a naval power must build to the limit in size and build uninterruptedly, or she will quickly begin to go under Age will tell, as shown by the big drop of the British battleship totals (due to age) from 548,250 to 192,483 tons. Also, *the tables prove that no single power can afford to disarm alone* It must be done jointly, by agreement, and pro rata, that is to say, the strength of the navies must be determined by a most careful, broad-minded and unprejudiced consideration of the several responsibilities of the naval powers *that may be represented* at the forthcoming conference in Washington.

Preponderance of United States in Capital-Ship Strength

We do not know of any stronger argument against the immediate completion of our six ships of the "Indiana" class than is presented by these comparative tables, and *particularly when they are viewed in the light of the fact that we have declared for a policy of equal strength with that of any other navy* Today, or rather by 1924, if the present programs of construction of the three leading naval powers are completed, we shall find ourselves in the position of being about equal in capital-ship efficiency to the other two naval powers combined. This would be in flat contradiction of our avowed policy The great inferiority of the British navy in capital ships will be somewhat compensated by her fine fleet of scout cruisers, a type in which, by 1924, we shall be relatively deficient. Her navy is also superior in its aircraft material, since it includes several aircraft carriers and a fleet of scout and bombing planes. A vital branch of our naval establishment which should be developed is the submarine service There seems to be a common agreement in the Navy that this service, so far as material is concerned, is below the standard of the rest of our fleet

The Moral of the Above Comparison

The supreme lesson taught by the tables given above is the one that has been *so frequently emphasized* in previous issues of the SCIENTIFIC AMERICAN, namely, that we should spend our future effort in balancing our present ill balanced navy, going slowly on battleship construction, rushing the battlecruisers to completion, laying down additional scouts, and building up *our submarine service* to the point where it balances with the rest of the fleet.

If we complete the six "Indianas" at once, our navy will be topheavy Wisdom dictates that we should direct the money that they would cost to building up our navy where it is weak.

The battleships can wait. A liberal coat of grease and red lead will prevent deterioration until we resume their construction. The contracts can be adjusted without any such absurd figures of loss as have been predicted.

Furthermore, the money directed from the battleships can be used to advantage in larger supplies of ammunition for target practise, in intensive training of the personnel, and in holding together our fine Naval Reserve—one of the valuable legacies of the war

TABLE SHOWING RAPID DEPRECIATION OF CAPITAL SHIPS THROUGH AGE

No Ships Armed with Guns of Less than 13.5-Inch Caliber Included in These Tables

United States

Battleships—	Date Completed	Displacement, Tons	No. in Class	Total Displacement of Class	Age in 1924	Percentage of life remaining in 1924	Displacement Efficiency 1924 as Reduced by Age
Indiana	1924	43,200	6	250,200	0	15/15	250 200
Maryland	1921	32 000	1	32,000	3	4/5	26,080
Colorado	1922	32,600	1	32 000	2	13/15	28,254
Washington	1922	32,600	1	32,000	2	13/15	28,254
West Virginia	1923	32,000	1	32,000	1	14/15	30,427
Tennessee	1921	32,300	2	64,600	3	4/5	51,080
New Mexico	1918	32,000	1	32,000	6	3/5	19,200
Idaho	1919	32,000	1	32,000	5	2/3	21,333
Mississippi	1917	32,000	1	32,000	7	8/15	17,067
Pennsylvania	1916	31,400	2	62,800	8	7/15	29,306
Oklahoma	1916	27,500	2	55,000	8	7/15	25,666
New York ..	1914	27,000	2	54,000	10	1/3	18,000
Totals .			21	722,000			554,407
Battle Cruisers—							
Constellation	1924	43,500	6	261,000	0	15/15	261,000

Great Britain

Battleships—							
Royal Sovereign	1916	25,750	5	128,750	8	7/15	60,083
Queen Elizabeth	1915	27,500	5	137,500	9	2/5	55,000
Benbow	1914	25,000	4	100,000	10	1/3	33,333
Erin	1914	23,000	1	23,000	10	1/3	7,668
King George	1913	23,000	3	69,000	11	4/15	18,400
Orion	1912	22,500	4	90,000	12	1/5	18,000
Totals			22	548 250			192,484
Battle Cruisers—							
Enlarged Hoods	1924	45,000	4	180 000	0	15/15	180,000
Hood	1920	41,200	1	41,200	4	11/15	30,213
Repulse	1916	26,500	2	53,000	8	7/15	24,733
Tiger	1914	28,500	1	28,500	10	1/3	9,500
Lion	1912	26,350	2	52,700	12	1/5	10,540
Totals			10	355,400			254,986

Japan

Battleships—							
Kaga	1923	40,600	2	81,200	1	14/15	75,787
Negato	1921	33,800	2	67,000	3	4/5	54,080
Ise	1918	31,260	2	62,520	6	3/5	37,512
Fuso ..	1915	30,600	1	30,600	9	2/5	12,240
Yamashiro	1917	30,600	1	30,000	7	8/15	16,320
Totals			8	272,520			195,939
Battle Cruisers—							
Amagi	1923	43,500	2	87,000	1	14/15	81,200
Atago	1924	43,500	2	87,000	0	15/15	87,000
Kongo	1914	27,500	4	110,000	10	1/3	36,667
Totals			8	284,000			204,867

COMPARATIVE STRENGTH IN 1924, AS MODIFIED BY AGE

Ships Carrying 12-Inch Guns Not Included

	Battleships	*Battle Cruisers*	*Totals*
United States	554,467	261,000	815,467
Great Britain	192,484	254,986	447 400
Japan	195,939	204,867	400,806

A capital ship is obsolete in fifteen years. The above estimates of efficiency in 1924 are based upon the number of years of useful life remaining to each ship in the three navies

Table showing loss of efficiency through age

The Cricket on the Wire

ONE of the most fascinating fields of scientific study at the present time is that of animal psychology For a number of years the workings of the mind of the higher animals, and particularly of the domesticated animals, including the dog, the horse, the elephant, the monkey and the parrot, have engaged the attention of large numbers of investigators. Likewise, the study of animal psychology has thrown some interesting light upon that of human beings, both of adults and of children, but it is comparatively recently that attempts have been made to study insects from this point of view Not long ago a learned German scientist, Prof Regan, made certain curious experiments with the ordinary field crickets by means of the telephone We are indebted to a writer in *Kosmos* (Stuttgart) for an account of the very interesting tests made and their remarkable results.

The experimenter began by enclosing four square meters of the floor of a room with glass plates. Within this enclosure he placed the receiver of a telephone, and likewise at some little distance from the latter, a glass vessel whose sides were covered with black pepper and which contained a male cricket The insect at once began to chirp loudly, whereupon an unmated female cricket was set upon the floor The newcomer slowly and cautiously made her way toward the invisible musician, but just then the professor lowered a bit of wire gauze over the top of the glass vessel containing the male cricket, which frightened the latter into silence Meanwhile another male had been placed in a distant room of the same building and provided with a small ball microphone connected with a very sensitive box telephone

No sooner had the voice of her first admirer been stilled than the female cricket heard the voice of her second male insect issuing from the telephone She at once turned her back upon the glass vessel which she had been approaching and moved somewhat hesitatingly but in the right direction toward the telephone Upon arriving at a distance of barely a centimeter from the receiver, she halted and appeared to listen intently to the *distant serenade This* experiment was repeated a number of times with other pairs of crickets and always with the same success Eventually it was found to be not necessary to begin with the voice of the first cricket confined in the glass house' These experiments while amusing *in themselves* are made with a serious object and the results are instructive They prove to begin with the delicate sensitiveness of the telephone even with regard to the sounds made by the lower animals. They also reveal hitherto unknown facts regarding the sense of hearing and the mental qualities of insects When the first experiments were made a loud tone telephone with a suitable microphone was employed, but it was found that this was inadvisable because of the delicacy of the organs of hearing in insects It was discovered, too, that these organs are not situated in the antennae, as was formerly supposed, but in the lower segments of the forelegs. When these segments are lost, the insect finds it difficult if not impossible to perceive the call of its mate These pseudo "ears' contain microscopically small strings resembling parchment in their nature and set into the rigid chitin shield The sound waves which strike these strings are carried through a small tube to the minute auditory apparatus of the insect, which resembles on a small scale a series of organ pipes From these the vibrations are carried by special nerves to the brain As will be seen this arrangement suggests that of the nerves in the cochlea of the human ear However the tones given *forth by insects are*, most of them, so extremely high as to be imperceptible by human ears

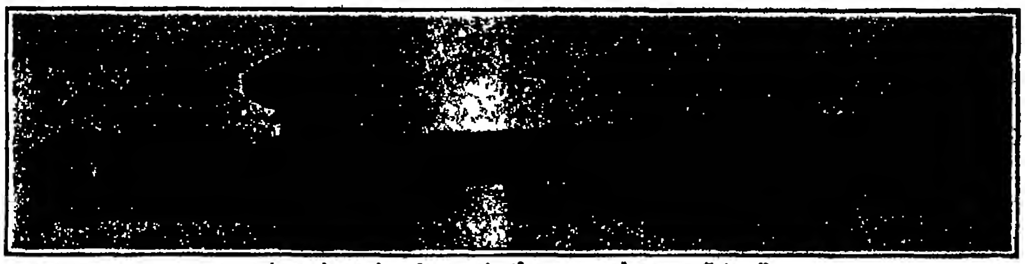
The peculiar chirping sound uttered by the male cricket is made possible by the circumstance that the left wing cover is almost entirely covered by the right wing cover This enables the insect to draw the right wing with an indented cross vein across a smooth outstanding vein on the top of the lower wing cover, with much the same motion as that of the bow of a fiddle The sound thus produced is extremely faint in itself, but it is greatly strengthened by means of four resonant bits of parchment like skin so that it can be heard for a distance of more than 100 meters (about 330 feet) It must be remembered that while the note sounds very monotonous to human hearers, it is not so to the crickets themselves This is shown by the fact that if a note be blown upon a pitch pipe of exactly the same height as the note made by the cricket, the animal makes no response to it, since its chirping is a far more artistic as well as a complex sound

From Opium to Hash Eesh

Startling Facts Regarding the Narcotic Evil and Its Many Ramifications Throughout the World

By Dr Carleton Simon

Special Deputy Police Commissioner in Charge of the New York City Police Narcotic Division



An opium pipe, known in the vernacular as a "stem"

"AND the opium came from the East where the fragrant poppy perfumes the air and where languorous dreams disguise the grind of dull monotony ' I might add to this thought And now comes hash eesh, an ancient drug, new to America, and one that would make a wooden Indian love a granite boulder It is probably the most violent of sexual stimulants, which accounts for its popularity It is usually mixed with gum opium

Before I go further into the subject of drugs and dreams, if a whimsicality is pardonable, I would mention here, the literature of drug addiction Few people know there is such a literature Do you remember De Quincy's "Confessions of an Opium Eater?" Here is a typical Chinatown lyric, abbreviated from a poem by George Hull, a writer of underworld fiction Hull, by the way, is the son of an East Indian Missionary

"Dr Fat of Chinatown, he makes fat people lean,
In the purple haze of a poppy daze,
'Neath dragons gold and green,
He sings his song, the whole night long
'Six bittee hop for you?' he cries, 'and four bittee hop for you?'
'You never hittee the pipe before, two bittee hop will do'
And all night long, he sings this song, in a tunnel at No 2
'You never hittee the pipe before, Two-bittee hop will do'"

The popular song writer sings, 'Dreamy, Dreamy Chinatown, Where the Lights are Burning Low'

The writer of more dignified lyrics pens, "In the Garden of Sleep, Where Poppies are Born' This, of course, is a symbolical lyric, but it suggests the poppy sleep and the dreams which Freud had not yet classified From the pocket of an addict we took a bunch of verses. Four lines from a long poem, describing the delights of early addiction read

"Oh, Dr Simon tell me true,
What did I ever do to you?
You passed a law that took my dope away
Give it back to me, I pray '

Jack Boyle, a wonderful writer, has given us, "The Poppy Girl's Husband' Motion picture literature is full of knock-down and drag-out drug stuff, and so addiction has produced a literature, but the drug literature that New York's Police Commissioner Richard E. Enright is interested in, is, "Written in the Statute Books."

The Commissioner is a farsighted man Not because he appointed me, but because he realized the heavy inroads the narcotic evil was making and the close connection between addiction and crime I regard him as a 100 per cent police commissioner

When drug addicts in the United States had reached the startling total of 1,088,000, quoting from the figure of Representative Rainey, of Illinois, Commissioner Enright decided on drastic measures. He realized that 90 per cent of addicts were criminals with records, in some instances, reaching from Vancouver to New York Then he asked me in to help clear the situation.

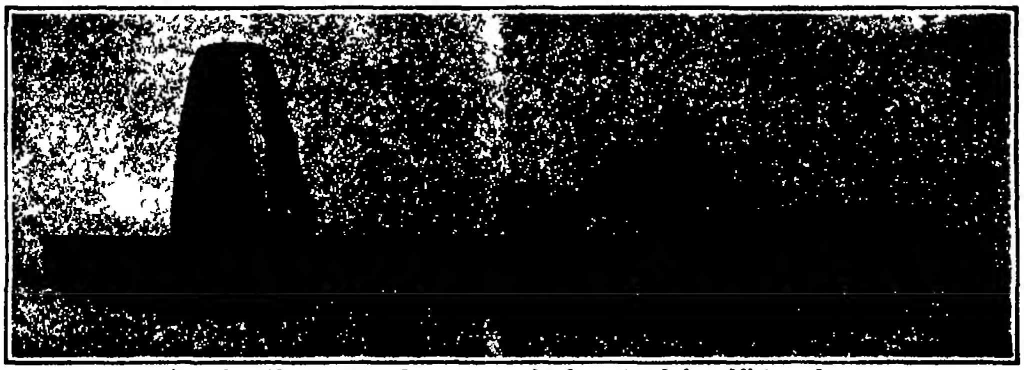
With my knowledge of drug addiction and underworld information acquired as an expert for the New York State Narcotic Commission, and extensive experience of a life devoted to the study of psychology and criminology, I considered it my patriotic duty to help crush this evil No financial gain or political ambition is involved in our crusade against drug bondage and its many ramifications.

From the standpoint of the police, all the romance of the songs and short stories is swept away on the fumes of a drug which brings depletion, depression, poverty, despair, crime and death, and only a world war waged night and day keeps this scourge from sweeping humanity to hell It *is* a world war, for I have secret mission men in Europe and the Orient, and have a close cooperative understanding and a system of information with practically all important cities in Europe and America. We have, now at Police Headquarters, the first and largest clearing house in the world on the drug traffic and drug addiction. We can furnish on short notice pictures and records of almost any known addict, smuggler or vendor in any city We have pictures and records sent us from the governments of France, Belgium and Canada, and reports by which we can feel daily the pulse of the activity of this evil

Not only in the hovels of the great East Side of New York and the slums of other cities is this reason-dethroning, death-dealing habit found, but in the mansions of the rich as well. It is a spreading fire that has to be fought with fire. I have in my personal possession a list of more than 100 prominent New York addicts. Among them are artists, theatrical people, writers, and at least one millionaire. Some are innocent victims, others have sought excitement and sensation, and go to the slums for their supply

The drugs most used are Gum opium and its derivatives, including codeine, paregoric, morphine, heroin, cocaine, a crystalline alkaloid, derived from the leaf of the cocoa plant, and the latest, hash eesh, derived from the Indian hemp, *Cannibas Indica*

From hash eesh, significantly enough, we derive our word assassin. This drug only recently has found its way into the United States, being smuggled by Turks and East Indians. It is not prohibited by the Harrison Federal Narcotic Law The only law covering it is the new Sanitary Code Law of New York City, under which our department now operates, and without question, this law will be added to the Federal Law It is no crime to possess, sell or use this terrible drug anywhere outside of New York City—for the time being, at least.



An opium "lay-out", or the necessary implements of the addict smoker

Addicts' methods of taking drugs are divers. Cocaine and heroin are usually snuffed Morphine is taken by hypodermic needle, or in the absence of a needle, an eye-dropper is used. The common method of using opium is smoking, and this is an intricate process, requiring experience. The gum opium has to be especially prepared. The gum is picked up in a "pill" about the size of a large raisin. It is placed on a tool resembling a darning needle, and called a "yen hock" (Chinese) With this implement it is rolled on a hot pipe bowl held over a peanut oil lamp and "chied" (Chinese for cooked). When chied the pill is pressed down hot over the small hole in the bowl, and the addict lying on hip, throughout the cooking and smoking process, holds the pipe over the lamp and, with a "long draw," inhales the fumes deep into the lungs.

There is no form of drug using so luxuriant as is smoking "hop" (Chinese for opium)

It remained for a drug addict to call attention to the fact that a fluid may be expressed under the skin by a puncture and pressure. The usual form of self-administering morphine by a street addict is to make a puncture in the skin with a safety-pin. An ordinary eye-dropper is then filled with solution and pressed against the puncture, the fluid being slowly forced under the dermis. Anyone who has never before seen this novel method employed marvels at the ease and rapidity of the injection. This idea, without question, results from the cheapness and ease in procuring the ordinary eye-dropper and was adopted also to avoid laws regulating the possession of hypodermic syringe and needle.

To stamp out the use, the smuggling and selling of drugs, my entire division work from fifteen to twenty hours a day. When I first took charge the force worked all at one time. This left many hours uncovered. I arranged schedules so there is a force covering the

A morphine lay-out, including the regulation physician's syringe and the addict's eye-dropper

city, including the water-front, day and night. I divided the force into four sections:

Section 1. Older and more experienced men, qualified to prepare and handle cases in court.

Section 2. Looks after street vendors, buyers and addicts.

Section 3. This is the most interesting, for it is the mysterious section—the source of underground information—all types of people who delve into the very heart of New York, into the boudoirs of fair ladies, into the dressing rooms of theatrical stars and among the leisure classes, where unrestricted vice may be maintained secretly in an atmosphere of supposed refinement.

Some of these secret agents delve into the lower social sub-strata and into criminal life—the degenerate denizens of the underworld, whose condition as social outcasts is rendered more helpless, hopeless and pitiable because of their slavery to drugs. Many of these secret agents never appear at headquarters and are known only by numbers. We aim to detect every drug user. We have spies everywhere and are proud of it.

Section 4. The marine section, covers most of the water-front, docks, piers and ships at anchor.

Smugglers, importers, vendors—all deal in illicit drugs for the same reason that they bootleg whiskey —for profit. I know of no criminal endeavor that brings quicker or larger profits. Adulterated for street sales, the profit on drugs is about 900 per cent. If the drug happens to be smuggled from Germany, you can add increased profits due to the rate of exchange of dollars for German marks.

Drugs for pleasure began so far back we can hardly trace the origin. We have traced the connection between crime and drugs back to the tenth century when certain tribal rulers used narcotics to incite subjects to murder.

I have definitely established the fact that there is a wealthy drug ring in Germany which vies for drug addict sales and world supremacy in this trade with Japanese distributors. Before the Harrison Law was passed the opium importation into this country, legitimate and illegitimate, was around 1,000,000 pounds or Chinese "tuns" annually. It is hardly possible to compute it at present, because smuggled importations are so carefully hidden. Drugs come in from Mexico, Canada, Eastern and Western Coast ports, from South America, Europe and the Orient.

All the opium needed for legitimate use could be raised in California. All the cocaine needed for surgery is a small part of what is used to add zest to sensation-craving lives.

The "movie" thriller does not exaggerate. One of our men, a brave, efficient young fellow, died from the effects of a kick administered by an addict in a raid. Cornered in a rooming house in Brooklyn, my men had a running gun fight, up and down stairs, into the basement and round about, with Spanish drug smugglers. One of the smugglers was shot dead, after a chair had been thrown through a window by one of our detectives to attract the attention of a waiting squad outside.

There is little drug addiction in China. The law is too severe. Our smugglers are Italian, German, Japanese and Spanish.

Almost every ship for a time carried some narcotic drugs. They have been found hidden in false bulkheads, coal bunkers and in a hundred different cleverly concealed caches. Chief engineers and other ship's officers and men have been corrupted by this smuggling ring and have been arrested by us. Individual smugglers have concealed drugs in shipments of olive oil and other freight, in children's hair, in heels, tongues and linings of shoes, in cartridge belts, and in a myriad of different ways.

Reason for the increase in drug addiction lies in the fact that an individual who takes drugs for a short period becomes an absolute slave to a demand which once created cannot be denied. This baneful influence becomes the greatest curse of civilization. The individual must have his drug. He has released a monster that must be appeased, that moral education, love of home or the best of intentions cannot hold in control.

Men who hold responsible positions, when they become addicted neglect their business. Their efficiency runs down the scale to inefficiency and they lose their positions. Gradually more of the drug must be taken to satisfy. The higher moral faculties, slowly but surely, are obliterated. The addict cannot work. Money must be obtained. They pawn their valuables and those of their relatives. Their household goods follow. The demand must be satisfied. The cost of their daily supply mounts from two or three dollars to from $10 to $15.

They have no way of getting this daily "dope" tax legitimately, and so they enter criminal life, and—many die from overdosage—others indirectly from malnutrition.

We draw a strong line of demarkation between the street or criminal addict, and the patient in care of a physician. We do not molest any reputable physician in the legitimate practice of his profession, or the poor unfortunate who is suffering from a disease and who requires alleviation from his pain. In the interest of humanity, the criminal addict, the street vendor, and the smuggler must go.

Opium from the poppy pod to the final retail package called a "deck"

A Photographic Innovation

PHOTOGRAPHERS have long desired to find a method which would enable them to develop negatives without the exclusive use of the dark room, since because of the dim light therein it is often difficult to judge whether the plates have reached exactly the right degree of development, and they are only too familiar with the fact that neither an undeveloped nor an overdeveloped negative yields the best results in the finished picture. This desire has become even more urgent because of the recent progress in the art of taking photographs in natural colors. A German inventor, Dr. Lüppo-Cramer, is one of the most recent claimants of the honor of devising such a process. The process in question is known as the "Safranin Process," and it is described by the inventor himself in *Die Umschau* (Frankfort) for March 19, 1921.

The new process is very simple, requiring for its operation merely a suitable amount of the red dyestuff known as *phenosafranin*. A solution of this substance is made in ordinary water in the proportion of 1:2,000, and 10 cubic centimeters of this solution are then added to every 100 cubic centimeters of the ordinary developing solution. Since the developing solutions have no influence upon the dyestuff, a larger supply than needed of the mixture can be prepared and kept in stock for the sake of convenience.

Developing solutions thus prepared have a very clear red color so that every detail of the picture can be observed with the greatest convenience and accuracy. Dr. Lüppo-Cramer makes the following remarks respecting the application of his process:

"The operator must take care to leave the plates for one minute in the red colored developing solution before exposing them to yellow light, so that the dyestuff will have time thoroughly to penetrate the sensitive film and make the latter non-sensitive to yellow light. I, myself, make use of a five-candle lamp enclosed by a very bright yellow shade, the development is complete within 1 and ½ minutes directly under the light of this lamp, no further precaution than that stated above being necessary. The course of the development is perfectly normal. Even from the most highly sensitive plates, provided, of course, that the exposure has been properly made, one obtains crystal clear pictures, even in cases where control plates, which have been developed without the addition of the pheno-safranin are entirely clouded.

After being developed the plates have a reddish tone not unlike that of the ortho-chromatic plates of commerce, but this red tint readily and completely disappears after the fixation and washing of the picture."

Since the protective effect of the solution does not depend upon immersion in the latter but is due to a chemical action of the pheno-safranin upon the silver bromide, the plate can be removed from the development from time to time and observed under the bright lamp light without risking clouding it.

Ortho-chromatic plates can also be developed in this manner under yellow light. Dr. Lüppo-Cramer continues:

"My process can be used to great advantage also in the case of pan-chromatic plates and of those which are sensitive to red light. Of course, in such cases, the lessening of the sensitiveness through the presence of pheno-safranin in the developer is not sufficient to permit of the use of yellow light. But very bright red light which will cause the plates to be badly clouded in an ordinary developer can be used without difficulty in the presence of the pheno-safranin."

While thus far we have considered a very brief use of the dark room and yellow light instead of pure white-light, the inventor gives further directions by means of which both of these can be dispensed with when to do so is convenient as during travel.

He says: "By observing the following directions the most highly sensitive plates, including those sensitive to color, can be developed entirely without the use of a dark room by *ordinary candle light*. The operator must immerse the exposed plate for one minute in a 1:2,000 pheno-safranin solution the light being, meanwhile, entirely excluded; he then lights his candle which should be placed at a distance of 1 and ½ meters (about 5 feet), after which the plate is taken out of the dye solution and placed in an ordinary development from which an entirely unclouded negative will be secured."

Dr. Lüppo-Cramer closes his article by a brief mention of a new and important field of application for the desensitizer discovered by him. Since X-rays remain practically undisturbed by the dyestuff in the sensitive film, plates intended for the taking of X-ray pictures can be previously impregnated by a suitable desensitizer and put on the market ready to use. Plates of this sort can be unpacked under a yellow light, placed in the plate carrier and developed without any previous manipulation. (The inventor has applied for a patent on his process of desensitizing X-ray plates.)

Colors of Antiquity

IN the Division of Dye Chemistry of the American Chemical Society at its recent meeting, Dr. J. Merritt Matthews gave as his opinion that the fast colors of antiquity were not so much due to the better dyes employed but to the fact that in the application of these dyes a great deal more care was exercised and a great deal more time taken. In the discussion it was pointed out that advances in economy in the application of dyes can easily be accompanied by a deterioration in quality which emphasizes again the point often made that American made dyes themselves are not so much open to criticism as methods used in their application. It has been pointed out also that methods are not apt to improve under present conditions when the price of fuel is such as to tend to shorten every process where heat is employed, such as, for example, the proper steaming of printed goods following the application of dye. One observer has said that the requirements of organized labor are such that the time of the men engaged in the work is shortened as much as possible. So long as these and similar conditions obtain it can hardly be expected that improvements can be made in the dyestuffs themselves which will altogether make up for deficiency in their proper use.

What Do You Know?

The Edison Questionaire—Its Aim, Its Results, and Its Collateral Significance

As Told by Mr. Edison to the Editor of the Scientific American

WHEN the newspapers first announced that Thomas A Edison was trying out candidates for executive positions by setting before them a list of 150 questions on all sorts of subjects, none of which had any direct connection with the work the men would be called upon to do if employed, there were many to scoff The amount of information a man has in his head on general topics, the number of isolated facts which he can produce from the recesses of his memory in a given time, were stated to have no possible bearing upon his fitness for executive work Mr Edison, in the face of biting criticism as well as misdirected endorsement, went right on subjecting his applicants to his questionaire, and putting to work the men who made the best showings Enough time has elapsed for him to make now the unqualified statement that the results have justified this unusual mode of selection. Mr Edison accordingly has been prevailed upon to tell, for this issue of the Scientific American, just what his idea was in setting these questions and why it has worked out so well. The article on these pages is the result of three conversations with Mr Edison, and contains the first authorized quotation in extenso of questions from his questionaires — The Editor.

PSYCHOLOGISTS today are vastly concerned with finding the right man for the job and the right job for the man So far as they have to do with selecting men for mechanical work, their methods are well developed, definite, satisfactory in their results But when it comes to picking brain workers the situation is different It is not so easy to set a man's brain to work before your eyes and watch it function as it is to check up on his fingers Procedure for the selection of executive workers is still chaotic, still leads to no definitely satisfactory or systematic results.

Yet it is here that the need is most keenly felt for testing a man's ability without actually putting him to work If we select the wrong man to turn crankshafts, the loss is limited to the number of crankshafts he can spoil before we find him out. Such a loss may be heavy, but it *is* limited The loss that may be caused by a weak executive is, on the other hand, quite without limit. Mr Edison says that single mistakes of minor executives have cost him as much as $5000, and where it can be as bad as that he is lucky if it has not been worse. For let it be remembered it is harder to locate a weakness in the executive force than one in the shop

Mr Edison has found out all this to his loss. "It costs too much,' he says, "to learn whether a man is a good executive by trying him out on the job So I made up my mind that we should have to have a formal test of some sort This brought up the question of what we should look for, what is the most important qualification for an executive?

"When I call upon one of my men for a decision, I want it right away When his department calls upon him for a decision, it wants it right away It's all very well to say that you have got to look up the data on which the decision will be based, that you know just where to look, that data and decision will be forthcoming tomorrow afternoon But I want the decision now, the department wants it now It isn't convenient for me to wait, and certainly it isn't convenient for a whole department to hang in the air for an indeterminate period waiting for an executive to find something out that he might have had right in his head My business is just like any other when a decision is called for it must be forthcoming And the man who is to make it must have all the pertinent facts.

"On this ground it seemed to me that the very first thing an executive must have is a fine memory I asked myself if I had ever heard of a high-class executive who lacked this qualification I hadn't have you? Of course you haven't So I determined that I should test all candidates for executive positions by learning what I could about their memories.

"Don't misunderstand me Of course it does not follow that a man with a fine memory is necessarily a fine executive He might have a wonderful memory and be an awful chump in the bargain But if he has the memory he has the first qualification and if he has not the memory he lacks the first qualification and nothing else matters. Even if after passing the memory test he turns out to be a failure and has to go, much motion and expense will have been saved by the immediate elimination of all candidates who lack this first requisite of memory

"The questionaire that has attracted so much attention and been the target of much criticism was got up on this basis The only way I know to test a man's memory is to find out how much he has remembered and how much he has forgotten Of course I don't care directly whether a man knows the capital of Nevada, or the source of mahogany, or the location of Timbuctoo Of course I don't care whether he knows who Desmoulins and Pascal and Kit Carson were But if he ever knew any of these things and doesn't know them now, I *do* very much care about that in connection with giving him a job For the assumption is that if he has forgotten these things he will forget something else that has direct bearing on his job

"This memory of ours works in two ways. The things that are always before you, that you are continually conscious of knowing, comprise an insignificant part of the contents of your mental warehouse. Every moment of your life from the time you were old enough to perceive things at all, facts and facts and more facts have been sifting into your mind through the things you see and the things you hear and above all through the things you read—through your every contact with the external world Millions and millions of facts which have come into your mind in this way ought still to be there They stay down under the surface until you call for them—then if you have a good memory you find them popping right out. A man with a really fine memory of this type will often surprise himself by remembering a lot of things which he would not have supposed he had ever known, and which he can't for the life of him imagine how or when or where he learned

"If I tell you something now, and you know that I am going to ask you about it tomorrow and that it is going to be important for you to know, you are a poor creature indeed if you can't make yourself remember it If I tell you something that interests you exceedingly, it is mighty strange if that doesn't stick, too But that is not the kind of memory that counts. Don't come here for a job and tell me that you can remember anything you want to, anything you consider worth remembering Out of every thousand facts that present themselves to you, I should think that at least 990 come unobtrusively, without the slightest indication whether they are to be of any subsequent importance to you or not If your memory is a success, it will reproduce—within the proper limits of human fallibility, of course—any one of these items, when and where you want it

"Of course if I ask you 150 questions at random, I am going to strike some low spots in your knowledge. I am going to ask you some things that you never have known at all No two people have precisely the same background of facts But I do not expect anybody to answer every one of my questions. They are selected with the thought that they shall deal with things taught in schools and colleges—things that we have all had opportunity to learn, facts to which we have all been exposed during the course of our education and by our ordinary reading Their subject matter is of no importance—they must merely be things that my applicants may fairly be assumed to have been taught at some time Everybody must necessarily have been exposed to a very large majority of them But if any candidate should answer every question on his paper, I should want to know where he got his advance copy of the questions! I am not looking for 100 per cent grades, but I am looking for, and I think I am entitled to expect, 90 per cent grades. A man who has not got 90 per cent of these facts at his command is deficient either in memory, as discussed already, or in the power of acquiring facts, as I shall presently make clear And either deficiency is fatal for my purposes."

Mr Edison's insistence upon memory as the object *par excellence* of his test surprised me. I had revolved the questionaire in my own mind, and had succeeded in justifying it on a somewhat different basis. It had seemed to me that it was reasonable to insist that men going into the employ of the Edison industries, or of any industry of similar scope, be all-around men of parts, and that the questionaire afforded a means of determining whether they were so, or whether their interests were so narrow that they had not taken the trouble to pick up the general knowledge of the world about them which they ought to have. But Mr Edison made me see that this was not the point at all. Unquestionably, if he is sufficiently educated to hold down an Edison job, the man has been exposed to practically all of the facts called for by the questions. It is then not at all a matter of whether he has been sufficiently interested in them to retain them deliberately, it is merely a question of whether he possesses the automatic memory that retains them anyhow If he has, as Mr. Edison says, he has satisfied the first requisite for an executive.

Mr Edison has a little anecdote illustrating this point admirably One of his foremen, passing through the shop under the eye of an inspector—a man who was hired on the basis of his A grade on the questionaire—walked directly past two men who were sleeping at their benches. He apparently looked at them, but they made no impression on him—he didn't see them. He was maneuvered about so as to pass them again, again his attention was not attracted by them This is where, in Mr Edison's estimation, the side of the picture opposed to mere memory comes in. You can't expect a man to retain what he has not taken in at all And there was obviously an impediment between this man's organs of sight and his perceptions of things seen. He would be likely to fail in the questionaire test through not having put his facts, in the first instance, in a secure enough place in the mental warehouse, through the same atrophy of the observational faculty he would be certain to fail repeatedly in the proper discharge of his executive functions.

"Somewhere between the ages of eleven and fifteen the average child begins to suffer from this atrophy, this paralysis of curiosity, this suspension of the power to observe. The trouble I should judge to lie with the schools, but its precise seat I would not venture to suggest. Perhaps it lies in a flagging interest, which leads quickly to the habit of listening without hearing, of looking without seeing—a habit which once fixed persists without regard to the existence or non-existence of interest. Whatever it is, it is clear to me that our schools and colleges are turning out men who not merely have failed to learn, but have been robbed of the capacity to learn."

Lest it appear that Mr Edison exaggerates the conditions, I prevailed upon him to permit me to examine in detail a considerable number of the more unsatisfactory answer papers from a questionaire that was set some months ago. I eliminated from consideration all men who were not indisputably college graduates. This left in my hands a considerable number of papers written by men who had gone clear through a university or college of rank, and had emerged with a degree. Practically all of them had, in addition, employment records justifying them in applying for a minor engineering job with prospects of promotion. I abstract some of the things these men knew that are not so.

Pittsburgh is 70 miles from New York, also 150 and 160 The distance from St. Paul to Minneapolis is anything you please up to a maximum of 250 miles, and those who know them for twin cities place them abreast one another, on opposite banks of the river.

Tierra del Fuego is in Mexico and it is in Spain. The Selkirk Mountains are in Sweden, Dakota, Tennessee, Scotland, Spain. The Wyoming Valley is placed by general consent in Wyoming. Kamchatka is a mountain in Japan. It is also "in the Adirondacks." Albuquerque is in Louisiana, in Canada, and in French Africa. The capital of Maine is given as Portland and as Bangor, which might have been expected, and as Bengal! Two candidates have the rock of Gibraltar on their right as they enter the Mediterranean. Khartum gravitates between China, India and Persia. Pamlico Sound is on Long Island, in Nova Scotia, and in the

place where we have always supposed Puget Sound to be. To make up for this we find Cape Race in Virginia, in North Carolina, and in "southeastern South America." Montauk Point appears in Maine, in Connecticut, in Nova Scotia. The Gobi desert is in New Mexico and Arizona, but the earth's equilibrium is preserved by the presence of the Painted Desert in Asia and in Africa. The leading city of Newfoundland is Halifax (three votes), Vancouver, Sydney—and Nova Scotia again!

Camille Desmoulins is identified as painter and writer, as author and dramatist, as plain author, and as actor Count Rumford "invented the baking powder that bears his name." One candidate took a chance on Machiavelli and described him as an artist, another man took a chance and reported him a painter and sculptor, a third conservative soul refused to take any chance at all and identified him as "an Italian." Plenty of men described James Watt as the inventor of the electrical unit that carries his name. Lord Kelvin was a distinguished economist and parliamentarian, and he invented the compass. Isabella's partner on the throne of Spain is given as Philip and as Alphonso (without any numeral) The wife of Napoleon III is given as Marie Antoinette and as "Helen": Helen of Troy, no doubt. In reply to the specific question, "What king of Egypt built the great pyramid?" we are told Pharaoh and Pharoah and Pharoh and Rameses and Ramasus, all of which I suppose might have been expected; then we are told Alexander, and we are told Archimedes! Genghis Khan appears to have had a checkered career as a Chinese Emperor, an "Indian character," a Turkish general, a philosopher of the same race, and the head of the Hungarian Soviet. The author of Robinson Crusoe was Robert Louis Stephenson, and Balzac was a Brazilian patriot.

There is a pronounced consensus of opinion that the capital of Bulgaria is Budapest with a small p, dissenting reports are filed in favor of Bucharest and Belgrade

Asbestos is a compound of magnesia and it is a product of blast furnace slag. The atmospheric pressure is usually given correctly, but it appears in one paper as 70 pounds and in another as 776. Graphite is 'the mineral base for making lead" Menhaden is a bay The liquid used in fire extinguishers is carbon dioxide Three candidates knew pepsin only as a flavoring, and one of them tells us it is got "from the tree of the same name" Forty per cent in favor of starboard as left seems pretty high. 606 is a war gas, and it is a washing powder. The geometric lathe is an instrument to measure the area of triangles.

Nothing could be easier than to name three leguminous plants cabbage, lettuce and spinach A second authority substitutes turnips for spinach, giving the same list otherwise Conifers are described as trees that "bear fruit yearly"; as "broad-leaved trees", as "trees like cypress and birch" If we had this chap up for oral examination we might learn why he groups these particular two instead of the crabapple and the weeping willow Asked to name eight fruit trees, several men stopped at six; one made the grade by including the grape, and another the blackberry

Great diversity of opinion exists with regard to the prevalent beast of burden in the Andes The mule has a plurality, hard pressed by the goat The donkey receives honorable mention There are two votes for the "lima" and one for the "alpacka."

The number of feet in a fathom varies from 5 through 27 and 30 and up to 5400. Asked to guess the freight on a carload of oranges from southern California to Chicago, the candidates give figures running all the way from $20 to $2000.

Where is metallic aluminum obtained? One man, determined not to go wrong, tells us "from aluminum ore." Asked to name ten different metals in commercial use, one man ran down at nine, one at seven, and one actually at five. Coal was included in one list, and one man named both steel and iron. Amber is described as a hard wood, and five men try to play safe by characterizing it simply as "a substance"

The function of baking powder is given as the sweetening of the bread by preventing acidity and alkalinity, and (by two men) as the rendering of the bread more digestible. Another candidate reasoned that if the active principle of coffee is 'caffein, that of tea ought in all fairness to be taffein A very respectable majority of the candidates whose papers I saw replied to the good old chestnut "Why can't you boil eggs on the summit of Pike's Peak?" with the explanation that the low atmospheric pressure raises the boiling point of water to an unattainable height. Another informs us it is because the proximity of the sun causes great heat.

The cause of the moon's phase is the tides. Several men differ from this, insisting that it is the earth getting between the sun and the moon.

Mr. Edison discussed the possible significance of all this at considerable length. On some phases of the matter he has very firm convictions, on others he is less decided or not at all. One angle on which we agreed thoroughly was that the low standards maintained in our schools and colleges have much to do with the phenomenon that has manifested itself in these questionaires. Mr Edison made a point here.

"If I had a man in my employ who was right only half the time, or a little more than half the time, he would last just about long enough for me to find him out—and that would not take very long But our schools consistently and persistently give passing grades to students who are right a bare 60 per cent of the time. I consider this a disgraceful procedure If they can't teach the boys and girls to be right more consistently than that it is about time they admitted their failure and gave up the effort to teach them at all In the good old days when a student had to be right practically all the time or take a caning and occupy a position of general disgrace, the school and the college produced far better results. I consider that a man who makes a grade of 50 on one of my tests has scored a total failure. Anybody who is not an imbecile ought to answer half my questions. It is after he has answered half and has started on the second half that the candidate should begin to find himself in some difficulty Just looking at it in the superficial way, the way the schools look at it, the man who grades 70 is 20 points better than the man who grades 50, the man who grades 90 is 40 points better than the 50 man But if we realize that 50 is the absolute minimum, and score on the basis of the candidate's performance with his second 50, the man who makes a grade of 70 has really accomplished 40 per cent of what we have set before him, and the man who gets as high as 90 has answered 80 per cent of the questions above the practical zero There is a lot more difference between 40 and 80 or between 0 and 40 than there is, respectively, between 70 and 90, or between 50 and 70 I have not the slightest use for a candidate who scales below 70—that is to say, who does less than 40 per cent of what I would hope that he might do The 70 man I consider poor picking It's the man who makes a grade of 90, which is just twice as good as the weak brother's 70, to whom I give serious attention

Do you believe that Balzac was a Brazilian patriot? Do you believe that Kamchatka is in the Adirondacks? Do you believe that Genghis Khan was the head of the Hungarian Soviet? Do you believe that Lord Kelvin invented the compass? Do you believe that the Egyptian king who built the great pyramid was Archimedes? Do you believe that the capital of Maine is Bengal? Do you believe that the reason you can't boil eggs on the summit of Pike's Peak is that the proximity of the sun makes it too hot? Do you believe that the cause of the moon's phases is the tides? Do you believe that blackberries grow on trees? Do you believe that the chief city of Newfoundland is Nova Scotia? Ninety per cent of the college men who apply for employment in the Edison industries believe these things and others things of the same degree of absurdity. Mr. Edison has in his office documentary proof of this statement What is the matter with our colleges, and what are they going to do about it?

"If our schools would stiffen their standards, and find a means of holding the intellectually lazy average student of the present day to these stiffened standards, we should find, I think, that the system of learning today and forgetting permanently tomorrow would go out of fashion. If the set, formal examination were given less prominence I should think that would help too A student must be of low caliber indeed if with printed text and written notes before him covering the entire work of the term, he cannot cram enough facts into his head and keep them there long enough to get past the examination When he has done this, so far as his present state of mind is concerned, he seems to be through with those facts—finished, he is never going to want them again, or worry about them The habit of forgetting, the habit of not even taking things into his consciousness except under certain extraordinary conditions, is a vicious and a subtle one which he is not able to shake off.

"I am not a schoolman; I do not propose to attempt a solution of the school problem. But the results of these questionaires make it entirely clear that the problem exists, as I have stated it. Of the first 718 men who attempted my questionaire, only 57 could be given the grade of 70 which, after being revised to a practical 40, means nothing but 'fair' Only 32 attained a mark approaching 90, enabling me to see where they had done four fifths of what was set before them to do, and earning a grade of A.

No test, of course, is of value on its own grounds alone. The correlation must be shown to exist between the thing for which we are looking and the thing which we find In plain ordinary language, the test must work I interrogated Mr Edison on this aspect of the case, and he was enthusiastic.

As fast as he finds them he takes his A men into his factory for training as executives. And they all turn out to be first-class executives When he runs out of A men he is sometimes tempted to step down, and try out some B men And they turn out to make very poor executives. That ought to settle it

Mr Edison is not at all blind to the fact that his procedure has side-lights far removed from the main aim of testing memory Some of these lend strength, some perhaps involve elements of weakness One little item in which he is greatly interested is the ability of the candidates to read his questions accurately One of his earlier questionaires contained the question What was the name of the wife of Napoleon III?' A disgracefully large proportion of the candidates stopped reading this question when they struck the familiar word "Napoleon, and answered "Josephine' or 'Marie Louise" The inventor regards this as further demonstration of his belief that the sense which makes for assimilation of the things presented by the external world is atrophied He also traces a connection between the careful reading of the question that leads to a correct reply, and the engineering instinct for identifying all the significant details of a problem and attaching to each its true weight

That this failure to read understandingly is far from rare a few more quotations from answer papers may make clear The mediocre man is utterly unable to establish the proper connections between his mind and the externals When we ask him "What are the active principles of tea and of coffee?" he replies "They are mild stimulants," or "The soothing effect on the nerves," or "The extraction of the flavoring by means of dissolving in hot liquid" He includes a surety company and a national bank in his list of three prominent trust companies, to the question "How is sheet iron coated with tin?" he replies "To prevent corrosion"

One encouraging feature of this questionaire business is to be noted The college men, taken as a class, are bad enough But they are so much better than the men who have not had any college that Mr Edison has practically made the college education a prerequisite for positions of the sort to which these questionaires lead Mr Edison can see where the colleges have failed measurably but their failure shines like success in comparison with the failure of the schools beneath them. The colleges apparently teach their students, at least to some extent, how to read for the questionaires indicate rather clearly that the facts picked up by college men in the ordinary reading of book and newspaper stick fastest

On the other hand, a new feature introduced into the questionaires only a few days before I talked with Mr Edison brings out an altogether discouraging result. To learn whether there are men who possess the mastery of process and the ability to reason while lacking the background of facts, Mr Edison included in the current questionaire five numerical problems that required merely the ability to reason and to handle elementary arithmetic He had his examiners report on these five questions separately from the bulk of the paper I cannot quote the questions because they are still "alive" But I can assure my readers that it would be a disgrace for any grammar school graduate to fail on three of them for any high school man to miss the fourth, and for anybody in the world to fail down on the fifth

Yet the results of these five questions were quite poor enough to justify any generalizations which Mr Edison might make about the inability of the college man to use his brain That they did not call for a specialized type of mind is indicated by the fact that the showings of the candidates on the five questions were strictly in proportion to their showings on the other 145 Many of the answers were wrong in such a fashion that the slightest degree of thought would have made evident their absurdity and their inconsistence with the terms of the question If an engineering graduate with engineering experience can't do simple arithmetic, Mr Edison seems justified in demanding to be shown what earthly use there is for him

1.—Painting the original drawing in oils on canvas

2.—Photographing the original for the various colors

3.—Developing the negative plate in the darkroom

4.—Retouching and opaqueing the various negatives

From Easel to Cover

Offset Lithography as Applied to the Scientific American Covers

By Austin C Lescarboura

THE artist of today has an unlimited audience His art may become known to tens of thousands—even to millions upon millions of persons, yet, strangely enough, this very condition often means that his original paintings are seen by few persons aside from the craftsmen who process them from the master subject to the numerous reproductions. In fact, this is the age of commercial art, and by far the greater number of paintings today are made not so much with their actual appearance in mind as with their reproduction qualities. In a word, most of our present-day paintings are made to please the camera, so to speak

A case in point is the SCIENTIFIC AMERICAN covers. The originals for all our cover illustrations are generally oil paintings on canvas, measuring 17 x 22 inches. Up till some four years ago the covers of this journal were printed by the process color method, on regular printing presses, but of late years the offset lithography process has been developed to such a point that there is no longer doubt about its superiority for faithful reproduction, especially in colors, and for rapid work In fact, it is ideal for publishing purposes. Hence it is our purpose here to describe how our original oil paintings are reproduced on our covers, while the accompanying sketches depict the progressive steps of the process.

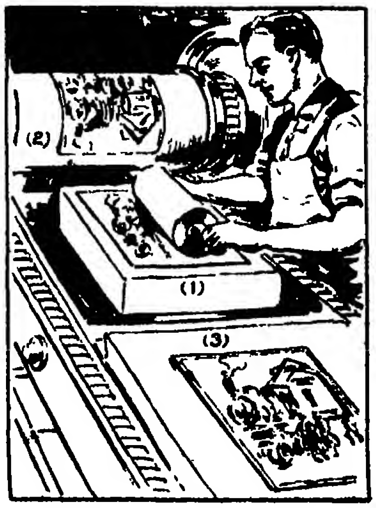
The original oil painting is the result of an idea originating in the editorial rooms. Sometimes the idea is due to a bit of current news, a clipping from a technical journal or Government report, or again a photograph or contribution. The idea is given to the artist, who works up a rough color sketch in order to show how the subject will work out The rough sketch is generally subjected to a number of changes, both in composition and distribution of color With these final data to go by, the artist transfers the details of the rough sketch on to a large canvas and works up the original painting with painstaking care, as shown in our first sketch

The painting, after being approved with or without final changes, is now ready to be reproduced. The first step is the photographing of this original and the separation of the color values, which is shown in the second sketch Anyone familiar with color photography knows that certain color filters cause certain colors to be filtered out while others are permitted to pass through and register on the negative in the camera This is precisely the basis of color reproduction processes The photographer places the original before the camera, illuminates it by means of powerful arc lamps, and carefully racks his camera back and forth until the proper sized image is obtained on the ground glass. Then he focuses the image as sharply as possible

The original is now photographed with various color filters in order to separate the different colors and obtain a yellow, red, and blue negative—the three primary colors, and black. The black plate is necessary for a sharp, clean-cut reproduction Do not misunderstand this statement the negatives are not colored yellow, red, and blue, but they do contain the latent values of each of these colors, so that when they are printed on to sensitized metal plates and those plates are duly processed, they will render the correct values of their respective colors so as to produce a faithful reproduction of the original

Wet plate negatives are employed in this photographic work, which is virtually identical to the photo-engraving process. The wet plates are simply large pieces of heavy glass coated with wet collodion carrying a relatively slow emulsion. That is to say it is not very sensitive to light, as compared with the highly sensitive emulsions of dry plates and films. The image is not permitted to fall directly on the wet emulsion, but must pass through a fine screen as in the case of the usual half-tone plate making This fine screen breaks up the image into a pattern of dots, with any desired degree of fineness, depending on the screen selected Screens are identified by the number of lines to the linear inch, the greater the number of lines the finer the dot pattern

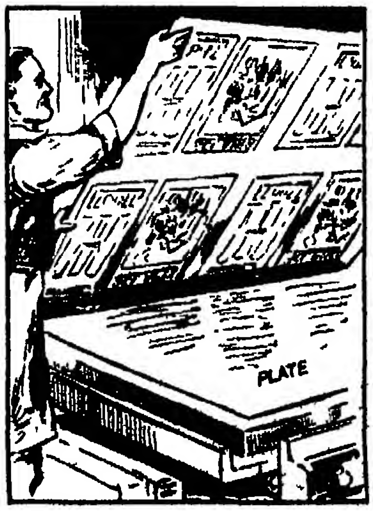
Once the image is registered on the wet plate, the latter is removed in its plate holder to the dark room. Holding the negative plate by one corner, as shown in our third sketch, the photographer merely pours the developing solution on the wet collodion plate and manipulates the plate rapidly so as to spread the solution over the surface in an even coat The image soon



9.—Proving the zinc plates on a special offset proving press

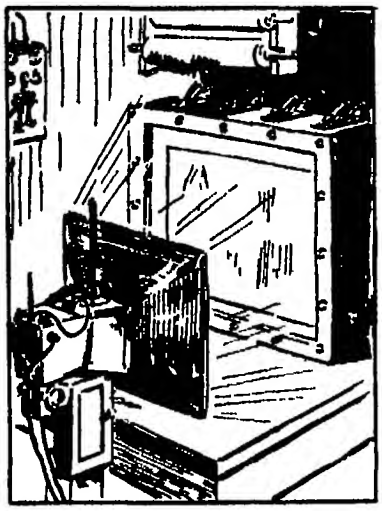
10.—Making the transfer sheets from the zinc plate original

11.—Graining the aluminum plate by means of rolling marbles



12.—Laying the impressions in position on to the aluminum sheet

5.—Drying the sensitized zinc plate over gas stove



6.—Printing the negative image on to the sensitized zinc

7.—Rolling up the zinc plate image with heavy ink

8.—Etching the zinc plate image with acid-soaked brush

develops, after which the negative is fixed in the usual manner so as to remove the free silver and leave only the desired blacks and half tone values.

As accurately as the camera does its work of reproducing the color values of the original painting, it is always necessary to retouch the various negatives in order to emphasize certain features and to subdue others. This work is done by expert retouchers and is known as opaqueing, shown in our fourth sketch. Certain parts of the negative which are not to be shown in the print are painted out with opaque ink, and others are strengthened the desired degree.

The next step is to prepare a zinc plate for each negative. The zinc plate is coated with a sensitizing solution and dried over a gas stove. *In order to heat the* plate evenly, it is held over a gas stove and twirled around quite rapidly by the simple arrangement shown in our fifth drawing. Once the zinc plates are ready, they are placed behind their respective negatives in a large printing frame and printed by means of the rays from a powerful arc lamp, as shown in our sixth sketch. *Considerable pressure is brought to bear on the negative* and zinc plate, and the heaviest kind of plate glass has to be employed in the printing frame.

With the image now transferred to the zinc plate, the latter is gone over with heavy ink. The ink is applied by means of a rubber roller, as shown in our seventh sketch. Successive applications of ink cause certain *parts of the zinc plate to be heavily coated, while others* remain untouched and clear. The zinc plate is now ready for etching. The acid etching solution is applied with a wide brush, as shown in our eighth sketch. The ink coating protects certain parts, while others are bare to the attacks of the acid. In this manner the image now becomes mechanically engraved on the zinc plate in a definite dot pattern.

At this stage it becomes possible to prove the offset plates, so as to make certain that the work is satisfactory. Indeed, the success or failure of an offset job depends primarily on the quality of the plates, hence it is well to prove them, in the parlance of the trade. For this purpose a miniature offset press is used.

Offset work, we may just as well say here, is, as its *name implies, the printing of a plate by offsetting it on* a rubber blank, which latter member then prints on the paper. Consider three cylinders revolving in mutual contact. The upper one is the plate, the middle is the rubber blanket, and the bottom is the paper. The impression on the plate is printed on the rubber blanket, dot for dot, just the same as the dots of the original plate. *As the cylinder revolves the print or impression* comes in contact with the paper, which is held to the pressure cylinder by means of a row of grippers similar to those used on the usual cylinder press. When the ink impression on the rubber blanket comes in contact with the paper each dot or line is pressed into the paper, whether it is rough or smooth, without smashing or *spreading, but with clean, sharp impression.*

Perhaps we are getting somewhat ahead of our story in describing the principles of the press work in offset lithography, but it is necessary to make clear what the workman is doing in the ninth sketch. The proving of plates follows the same general scheme as the press work. The zinc plate is placed at 1, on a stone block, *and is carefully inked. The cylinder 2, covered with a* rubber blanket, is rolled along and passes over the zinc plate, so as to receive the impression from the zinc plate. Rolling still farther along, the roller comes in contact with the piece of paper shown at 3, impressing the image on to the paper. Thus the zinc plate transfers its image on to the rubber blanket, which in turn *transfers it to the paper. In the case of* Scientific American covers, the zinc plate for each color is proved in turn, and great care is exercised so that the successive plates, inked with their respective inks, will be impressed on the same sheet of paper so as to give the final reproduction in full color. The care comes in registering the various plates so that their images will fall in the exact same space on the sheet of paper, making *for perfect superimposition.*

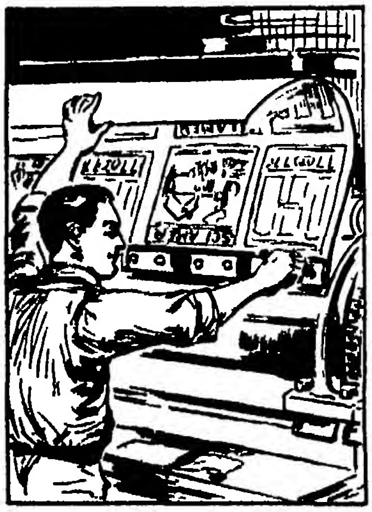
The colored proofs are submitted to the editors for their approval. Occasionally certain improvements may be suggested. Thus the colors may be too vivid, or the background may be too strong for the foreground, or the retouchers may have been too artistic in their efforts to strengthen the negatives. With the colored *proofs once passed upon the process moves on to what* is called the transfer phase.

The method of duplication of a single plate on to the large plate from which the covers are actually printed is accomplished in the same way in which transfers are made for the stone lithographic process. It must be remembered that up till this time we have had but a *single set of plates to deal with, and it is obvious that* if a single set of plates were employed for the actual presswork, the time required would be considerable on an edition running into one hundred thousand and over. Hence it now becomes necessary to transfer the zinc plates on to another printing surface and to obtain four sets of plates instead of one, so as to reduce the press *work to one-fourth the running time. Each zinc plate* is rolled up with ink, and the transferer pulls an impression direct from the zinc plate on to a sheet of India paper coated with a thin application of gum and glycerine, as shown in our tenth sketch. If four sets of plates are to be used for printing, four good proofs of each zinc plate must be pulled.

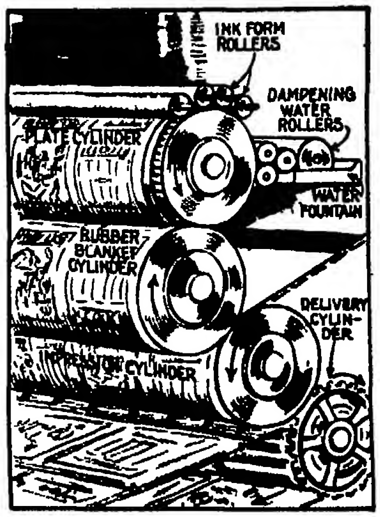
(Continued on page 80)

13.—Removing the transfer sheets from the aluminum sheet

14.—Etching the aluminum sheet by means of acid-soaked sponge



15.—Clamping the aluminum sheet on the roller of offset press



16.—General principle of the offset press and how it works

Our Point of View

The Aim of the Scientific American

DURING the St. Louis Exposition we met, personally, for the first time, a distinguished European physicist, who was engaged in pioneer work of a very special character Modesty forbids our repeating in full the terms of praise in which he spoke of the SCIENTIFIC AMERICAN, which he had received and read for a long period We had the curiosity to ask him why he gave so much attention to a journal which, because of its wide field, necessarily devoted but limited space to the special subject covered by his particular work He replied that he valued it as a 'scientific newspaper,' which gave him a faithful record of all the more important developments in the broad field of science, and, so, kept him in constant touch with the world's progress in activities that lay outside his own. "You have not space for exhaustive treatment, he said, "but the digest and comment which you give are sufficiently comprehensive and so well chosen and directed as to give one a clear understanding of what is being done I should think that, in addition to taking the paper which covers, in detail, his own particular field, every technologist would feel the need for that general information and comment which the SCIENTIFIC AMERICAN provides."

We quote the above tribute because it expressed, exactly, the aim and scope of the SCIENTIFIC AMERICAN WEEKLY The MONTHLY, of which the present is the first issue, will follow the same policy, with the added advantage that, where it is desirable we shall be in a position to give the subjects a more extended treatment than was possible in a weekly publication

Frequently we have been asked how we gather and prepare the current scientific "news." It is done by the Editorial Staff in the home office, which keeps its finger on the pulse It is done also and largely by correspondents in the leading cities, the Universities, and the laboratories of the world Another fruitful source of information is the voluntary contributions of scientists, engineers, inventors and others, who find that our pages are open to anyone who has a plausible theory or a proved accomplishment to place before the public.

Neither "high brow' nor popular,' we aim to strike a reasonable mean between the two The Editor both "writes down" and 'writes up" One day he may translate the Einstein theories into the nontechnical phrases of everyday life, the next day he may have to take the crude drawings and description of an unlettered mechanical genius, and bring it up to the standard of the draftsman's drawing, and of accepted, intelligible English Writing down from technical to every-day English is the more difficult half of our work Some years ago we requested a leading American bridge engineer to write for us an article, describing how he went about the task of designing a large cantilever bridge. He demurred on the ground of the time and labor that would be involved, 'I could dictate in an hour an article for a purely engineering publication—it would take me many hours to do so acceptably for the SCIENTIFIC AMERICAN"

Are we a "popular" magazine? Yes and No. The SCIENTIFIC AMERICAN is popular in the sense we have explained above, we write for the *populus*, the whole people—for the factory president and the college professor no more than for the workman and the student —for the farmer with his agricultural college training no more than for his hired man. In these feverish days the term 'popular," as applied to scientific journalism, has become first cousin to the term "sensational." Mere sensationalism the SCIENTIFIC AMERICAN abhors only less than the Devil hates holy water

In concluding this reference to our aims and purposes, we wish to make it clear that, although we appear henceforth in a more bulky form and in a new dress, there will be no change in the essential features of our policy as we have outlined them above Merely, we shall do the work better In a monthly, this task of recording and explaining the world's progress in science (knowledge), art (accomplishment), engineering, industry and other related fields, can be done more thoroughly, with better illustrations, and a more complete recording of the facts, than was possible in the rush of a week-to-week publication.

Ships of the Air and Ships of the Sea

THERE is a much closer parallelism between the dirigible, the ship of the air and the Atlantic liner, the ship of the sea, than most of us realize. The greater part of the disasters to the early dirigibles of the indefatigable Count Zeppelin and not a few of those that befall the airships of today, are due to a failure to realize how largely the laws which govern the steamship govern the airship also. Some simple considerations of the problem will convince one of the truth of this statement.

In the first place, from the time of her launching, when the ship has slipped safely from her ways and the whole vast but comparatively fragile shell of the ship is water-borne, ceaseless care has to be taken to prevent her hull from coming in contact with that very Mother Earth upon which it was laboriously constructed Let the captain of a well-found ship of today have plenty of offing, good charts, a reasonable number of opportunities to take observations, and he knows that his ship is safe. Except for the risk of collision with other ships which, thanks to modern inventions, is a remote contingency, the only time when the vessel is in danger of loss is when she approaches land where, through carelessness or unforeseen chances of wind and weather, she may run upon a shoal or be piled bodily upon the sands or rocky coast of the shoreline When the hull of the ship has to be subjected to its periodical inspection, she is towed with great care and at very low speed to a costly dry dock, in which she is brought to rest gradually upon a specially prepared bed of blocking, so distributed that no part of the hull will be subjected to undesirable stresses. In other words, the ship is designed to float in a fluid medium which is her proper home, and ceaseless care is exercised to maintain her in that fluid and prevent, above all things, any contact with solid land

Now, the ship of the air, like the ship of the sea, is designed, also, to float in a fluid, known as the air, and, provided that her hull is built with proper strength, she is perfectly safe so long as she floats in that medium The great mistake of the builders of the early Zeppelins lay in the fact that, whenever the airship came into port, so to speak, she was brought down to land, "beached," as it were, and, because of the winds, whirlings and cross currents of the air, she was exposed to very great danger of wreckage whenever such landings were made In other words, the early airships were subjected to the difficult and always rather risky operation of dry docking at the end of every trip. A tabulation of the wreckings of the early Zeppelins will show that the majority of the disasters which occurred were due to the attempts to bring them safely to earth

Many years ago, the SCIENTIFIC AMERICAN drew attention to these cardinal facts and suggested that we should handle the dirigible as we handle the ship which, when it comes into harbor, steams up to a mooring, makes fast to it head-on, leaving its hull free to swing with the tide; thereby subjecting the vessel to no greater strain than that which comes from the pull of its mooring cables, which, being taken at the head of the ship, is distributed harmlessly throughout its structure. During those early years of experimentation the SCIENTIFIC AMERICAN suggested that the airship, like the steamship, should not leave its native element when it comes into port, and that it should swing to a mooring like its sister of the sea. Subsequently, this principle was worked out successfully in Great Britain, and it has now been accepted as the only satisfactory way to meet the problem. Dirigibles of the largest size have been moored to tall steel masts and have ridden to these moorings, in one case for many weeks on end and in stormy weather, most satisfactorily. The advantage of this method is that when the airship has to go into dry dock, that is, into its air shed, a suitable day with calm weather can be chosen and the transfer made without undue risk.

However, the practice of bringing the airship to earth is still too general and it involves an enormous amount of risk. Indeed, there is something positively absurd in the sight of 300 to 400 human beings hanging on to a vast number of ropes and trying to guide a monster dirigible into dry dock. Those of us who went down to Mineola to see "R-34" two years ago must have realized what a crude method of handling this was, in an age which prides itself upon the high level of development to which practical engineering has been carried.

What Is the Matter With Our Schools?

OPINIONS will vary widely as to the propriety of expecting educated men to have at their immediate command a mass of isolated facts of the sort called for by the Edison questionaire. Under many circumstances the man who knows where to find these facts is quite as well off as the man who carries a full cargo of them in his head. And since the college training of the present day leans toward the mastery of sources, the ability to read profitably, and the proper handling of facts rather than their mere warehousing, it may not be fair to condemn the colleges on the mere ground that their graduates have not at immediate command a large proportion of the facts which underlie their education.

Critical examination of the results of Mr Edison's questionaire will deny this hope. Mr Edison says that in his business he can't pardon the man who has lost contact with his facts. Anybody else who wants to pardon him may do so—provided the forgetting is on a respectable basis. The man who does not know the leading city of Newfoundland, the identity of Balzac, the distance from Minneapolis to St. Paul, can look these things up, having done so, he is as well off as the man who does know But anyone who calmly tells us that Nova Scotia is Newfoundland's metropolis, that Balzac was a Brazilian patriot, that the twin cities are 250 miles apart, is just plain ignorant. He doesn't know that he doesn't know, presumably he will act on his false premises as though they were valid. And his "information" is so utterly and absurdly at variance with the facts, a man who doesn't know that these things can't possibly be is lacking in common sense

Our educational institutions are not responsible for the existence of such men. But large numbers of these men are being turned loose upon the world holding degrees from colleges and universities of high standing What is wrong with the system under which this can occur?

One thing that is wrong Mr Edison makes very clear The average college student may have one or two subjects in which he is especially interested and in which he makes a grade of B or even A. But the average collegian, as regards his general level, is just a C man. This means that he is right from 60 to 75 per cent of the time. What business, profession, trade, or other means of doing his part in the serious business of the world is open to him, in which he can possibly get by with any such showing?

Even the grade of C is often teased out of him. His instructor stands over him while he recites, correcting each mistake as he makes it, and finally succeeds in dragging out of him what by due exercise of charity may be recognized as an approximately 60 per cent performance. If, on his examination, he falls below the ultimate level of passable mediocrity, his class room work done in this manner, and his outside assignments probably done through more active assistance, are appealed to to bolster his average. The whole aim of the system is to boost the student by any means over that 60 per cent hurdle.

Our Point of View

We have taught all branches of college mathematics, always to men who had come to us direct from the prerequisite courses. Eighty per cent of them could not pass the easiest kind of an examination in the more elementary course, to save their lives or their degrees. And are they apologetic or embarrassed? Not they. they are indignant that they should be expected to know anything about last year's work They protest at being marked down because of such ignorance this isn't an algebra course, it is calculus, seems to be the theory, what difference does it make whether I know any algebra or not?

The system of examination is largely responsible for this spirit Mr Edison points out that a man with note-book and text at his disposal, who cannot prepare himself to squeeze through a written examination of which the date is fixed weeks in advance, must be mighty poor stuff. And then, having passed such an examination, as conducted in our schools and colleges today, the student will let go of the subject with the feeling "There; that's over with! I shan't ever have to worry about *that* again."

The only satisfactory examination is an oral one Here the evasive or the ambiguous answer can be followed up, and the full depths of the candidate's ignorance or knowledge plumbed. On every ground oral examination is the way to find out what a man knows, written examination the way to avoid finding out. Is this the reason why the written test is so general throughout our educational system?

Whatever the cause, whatever the remedy, Mr Edison's questionaire furnishes new concrete evidence of what many of us have long suspected. Our educational system is in a bad way The only people whom it educated successfully are those who have the capacity for educating themselves against all obstacles. Its real mission, of educating the average student to a point above what he could hope to attain unaided, is not being fulfilled. If the universal tendency to make school more attractive, the work more easy, the learning more appealing to the student, is responsible for this, let us acknowledge it and get back to the severer ways of a past generation. Learning carried no [illegible] the little red schoolhouse on the New England hill, nor in the college of fifty years ago If the present generation is eating off the sugar and rejecting the pill, we should change the mode of administering the dose.

A Navy Equal to Any

IT would not be possible to find a stronger argument against the immediate construction of the six 42,800-ton battleships of the "Indiana" class, than that which is presented by the comparison of naval strength in our article on page 11 of the present issue This analysis deals, it is true, with capital ships (battleship and battle-cruisers) only; but when we remember that the General Board has affirmed, with the strongest emphasis, that the battleship is "the backbone of the navy," it will be felt that we have chosen the true basis upon which a comparison of material and military strength should be made.

Although the introduction of the question of age, as we have used it, is something new in such comparisons, it is surprising and unfortunate that this most vital factor has not been applied before. Comparison by mere displacement has little significance or value. A naval expert would rather be told *how old* a ship is than *how big*. Single salvoes served to destroy three battle-cruisers of Beatty's fleet that were built in 1908 and 1912—it is probable that the "Hood" of 1920 would have taken those salvoes without impairment either of her speed or fighting power

We wish to make it perfectly clear that the steady fall in the value of a capital ship is not due to material depreciation (it is too well taken care of for that) but to the great improvement upon its design, which marks the ships that are built in each successive year. Thus, the appearance of the "Dreadnaught" instantly relegated all existing battleships to the second line. The "New York" in 1924, considered by itself, with no reference to any other ship, will be 100 per cent efficient, but measured against the "Indiana," she will be but one-third efficient.

The General Board of the Navy has declared itself for a *navy equal in strength to any other* and Great Britain, who, of course, is most nearly affected, has announced her cordial acceptance of that policy But if we push on to completion, in time of peace, the huge addition to our fleet which was contemplated in the 1916 program—a war program—we shall not only, so far as "the backbone of the navy" is concerned, be equal to the next strongest, but we shall be twice as strong as Great Britain and equal in strength to Great Britain and Japan combined How so? Because the bulk of our capital fleet, being absolutely new and up to date, will have suffered no military depreciation.

Has the American nation any such ambition as that? It has not, nor is the taxpayer prepared, just now, to lighten his already depleted purse to the extent of the several hundred millions of dollars which he would have to hand over to gain such naval predominance.

The fleet is battleship topheavy, the General Board has been so obsessed with big-displacement, big gunned ship that it has failed to make adequate provision for what is known in naval parlance as "information" Information can be gained only by battle-cruisers, fast scouts, and scout airplanes operating, far afield, from those mobile, floating bases which are known as aircraft carriers. In vessels of this type we are as deplorably weak as we are, or shall be, immoderately strong in battleships. It should be the future policy of the General Board to rectify the balance

The Value of Disasters

PANIC of judgment, induced by engineering disasters, has no right or place in the scientific mind. In the popular mind it is inevitable, as the files of the daily press will show The workaday world is controlled by its day-by-day impressions. The initial success of a new invention means a "revolution" in the art, a subsequent disaster, involving loss of human life, means, for the average man, the curtain on the last act

Not so with the scientific mind, which, delving patiently in the ruins, brings up many a golden nugget of evidence, traces the disaster to its ultimate cause, and writes down a series of findings, upon which the art may go forward to a more secure construction

The fall of the first St Lawrence River bridge during its erection, when a huge cantilever, some 1500 feet in length, with its 400 foot tower, crumpled up and fell into the river, was appalling, even to the engineering world, whose members might well have asked if there were some unsuspected law, which forbade the use of the cantilever principle in a span of this length and form. But there was no panic—rather a resolve to find the initial cause of the disaster by a patient examination of the records and of the fallen structure itself The disaster was traced to a very insignificant cause —the failure of some small angle-bars, 3½ inches in width, which were supposed to hold in place the parts of the huge compression members which failed The engineers of the bridge apparently never suspected that these bars would be unequal to their work. They represented standard ideas of commercial bridge building in that day It took the failure of this monumental structure with a loss of eighty lives to point out the unsuspected danger which lurked in the latticing of huge compression members, as practised by the bridge companies. Safer rules of construction were adopted, and the security of big bridge construction safeguarded

It took the Baltimore conflagration to teach us the strong and weak points of our much vaunted systems of fireproof construction Only when San Francisco, after repeated warnings, had seen the whole of its business section shaken down and ravished by fire, did she set about the construction of a city which would be proof against fire and earthquake It was the spectacle of maimed and dying passengers being slowly burned to death in the wreckage of colliding cars that led to the abolition of the heating stove and the oil lamp, and it was the risk of fire, coupled with the shocking injuries resulting from the splintering of wooden cars in collisions, that brought in the era of the electrically lighted, strong and incombustible steel car So, let us hope, the investigation of the loss of "ZR 2" will lay bare the particular fault of design or material, which caused the disaster, thereby recovering for airship navigation as a whole such loss of prestige as it has suffered

The Control of Atomic Energy

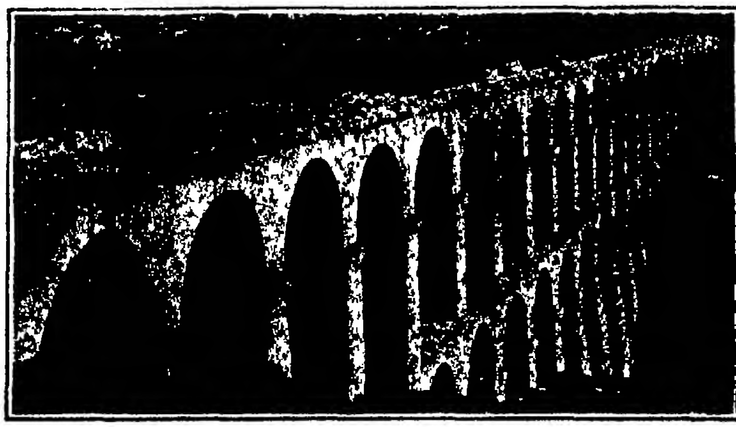
THE first announcement of the enormous potential energy stored up in a particle of radium produced a state of the public mind which varied from mild incredulity to vehement denial But the proof was forthcoming, and scientific authority has convinced the world that there are substances which send forth ceaseless streams of energy, and (here is the wonder) do so with a loss of substance so small that it takes the most delicate processes of the physicist's laboratory to measure the change

It had long been suspected that there was a vast storehouse of energy locked up in the atom, and the production of radium and the measurement of its kinetic activity set the seal of positive scientific proof upon the theory But, more than that, it has revealed to mankind the amazing the tremendous fact that we are in the presence of a storehouse of energy so vast and so intensive that he who shall first unlock the door will be possessed of a power in the presence of which all the vast potentialities of the world's store of coal, oil, waterpower will literally sink into insignificance

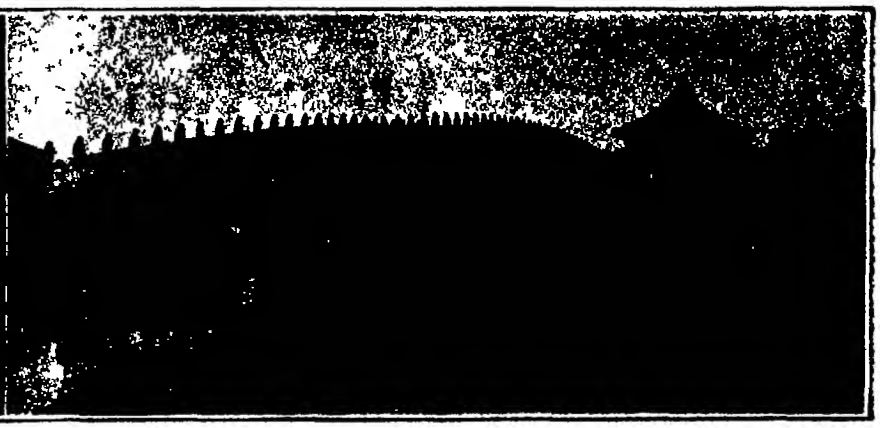
Hence it was very natural that the subject of atomic energy should be well to the front in the recent Convention of Chemists in this city, where some of the best papers were devoted to a study of the ever recurring question, these days, as to how and whence the coming generations will secure the needed energy for light, heat, transportation and the thousand-and-one activities of human life In this search we have at one time or another considered (with more or less doubt as to their filling the huge demand) coal and oil, natural gas, the energy of the earth's rotation and that of the wind, the tides, and the waves Waterpower, of course, is included, and we are told that the solar heat that beats upon the Sahara desert represents, in energy, the equivalent, daily, of some six billion tons of coal But none of these possibilities is so attractive as that of atomic energy

It must sometimes seem to the man who considers the question of the power of the future that nature has conspired against us. Every source of power that we have learned to utilize involves the using up of some material resource at a rate absurdly more rapid than is consistent with its continued availability to many generations of our descendants. Every source which seems a permanent or reasonably persistent one defies our efforts to put the harness to it But the chemist reassures us with the statement that he is making progress in his attack upon the most spectacular and the most inexhaustible of all the suggested sources of energy And when we survey the happenings of the past twenty years, and see to what base uses the best products of science and invention have been put, we may be reconciled to the slowness with which we approach the ultimate goal of unlimited free power

It was Rutherford who said "the race may date its development from the day of the discovery of a method of utilizing atomic energy" So enormous is this energy that it will confer upon the man, or the race, which learns to release and control it, a power only less than that of the Omnipotent. Before that day arrives let us hope that a way will have been found to put more of the human in what we are pleased to call human nature



The monumental Roman aqueducts are an historical landmark. This one stands today at Tarragona, Spain



The Chinese are the earliest recorded bridge builders. This structure, built entirely of marble, has both architectural beauty and dignity

Some Aspects of Bridge Architecture

A Bridge Should Combine Grace and Dignity With Strength and Permanence

By Dr. Eng. Gustav Lindenthal, C.E.

"ARCHITECTURE," as defined by Ruskin, "is the art which so disposes and adorns the edifices, raised by man for whatever uses, that the sight of them may contribute to mental health, power and pleasure." Among the prominent edifices of mankind are the great bridges. Their architecture in all countries marks in a peculiar way the progress of mankind in the art of construction, considered as an index of its civilization and culture.

It is a characteristic fact that the architecture of buildings precedes everywhere the architecture of bridges, the reason being that structures growing to height and resisting merely weight and loads are easier to plan and to build than are structures carrying weight and loads over free space. It requires of the builder greater skill and judgment to create a self-supporting stone arch or a high-arcaded aqueduct than to erect a pyramid or obelisk, a palace or spire.

Thus, the Egyptian masterbuilders were able to erect 4,000 years ago marvellous temples, of so enormous a size and of an architectural beauty so magnificent, that no structure built since then anywhere can equal them. Yet the flat stone roofs of their gigantic halls had to be carried on columns, standing close together, for the art of bridging space with arches was unknown to them. It was also unknown to the wonderfully skillful Hellenic architects. Had the ancient Egyptians or Greeks known the art of arch construction, they would have bridged the Nile as the Romans bridged the Tiber.

The Era of Bridge Architecture commences with the stone arch. The invention of the arch is usually credited to the Etruscans. Although stone arches appeared about 600 B C, it was many years before Roman architects were bold enough to attempt stone bridges over the Tiber, the first of which were built in the first century B C. Some of these are still in use.

The earliest forms were, of course, crude, mostly the half circle on low abutments. With increasing experience, higher and bolder arch bridges were built on piers, many in the form of long viaducts and aqueducts consisting of two and three stories of superimposed arch arcades. They were great achievements when we consider that the Roman architects had only poor equipment for laying out their work, and that the tools of their artisans and craftsmen were of the simplest kind.

What wonderful vaulted monuments these great masters, whose very names are unknown, would have created in that wealthy age, with its love of the beautiful and its exquisite sense of proportions, had these men possessed the modern accurate knowledge of the strength of materials and of mathematical statics! But such knowledge did not exist until less than 200 years ago. A few empirical rules, evolved from experience and failures, sufficed for the construction of the architectural wonders in the form of castles, great cathedrals, palaces and bridges through all the centuries, extending from ancient times to the beginning of the Renaissance. As it is, throughout Europe we find evidence of refined architectural forms in the stone arch bridges. There must have also been many fine wooden bridges, but no trace has been left of such perishable structures.

Towards the end of the sixteenth century, the opulent, art-loving Italian cities, also encouraged competition of designs for beautiful bridges. The same architects that designed their churches and palaces, designed and built bridges. From that period we have inherited the famous Rialto Bridge in Venice by Antonio da Ponte, and the beautiful elliptical stone arch bridge Ponte della Trinita in Florence by Bartolemeo Amanati. There are also a number of smaller bridges, veritable architectural gems, by the contemporary Andrea Palladino, the leader of the Italian Renaissance in architecture. The flat segmental form of arch makes its appearance, the piers receive a slimmer and more elegant form, the adjoining river shores are terraced and brought into architectural harmony with the bridge structure as a whole. Decorative sculptures commemorate historical events and give expression to the dignity of the community. The cunning workmanship of the bridge balustrades, the graceful profiles of the cornices, the imposing gates and tower entrances, all speak to us of the ambition of the masterbuilders, of the civic pride and public spirit of the people, and of their love for the beautiful and harmonious in their surroundings.

One hundred years later the leadership in artistic bridge designing went to France, where a great impulse had been given to Arts and Sciences by Louis XIV. M. Perronet was the recognized master bridge builder of that time. His designs are distinguished by elegance and stateliness of proportion and finely executed stonework. He developed the flat elliptic arch, and to him we owe many beautiful stone bridges in France. The first stone bridge in St. Petersburg over the Nerva was also from his designs. His method appeared also in the London Bridge. Perronet's bridges at Neuilly over the Seine and the Concord bridge in Paris will always be regarded as among the finest examples of architectural distinction in stone arch construction.

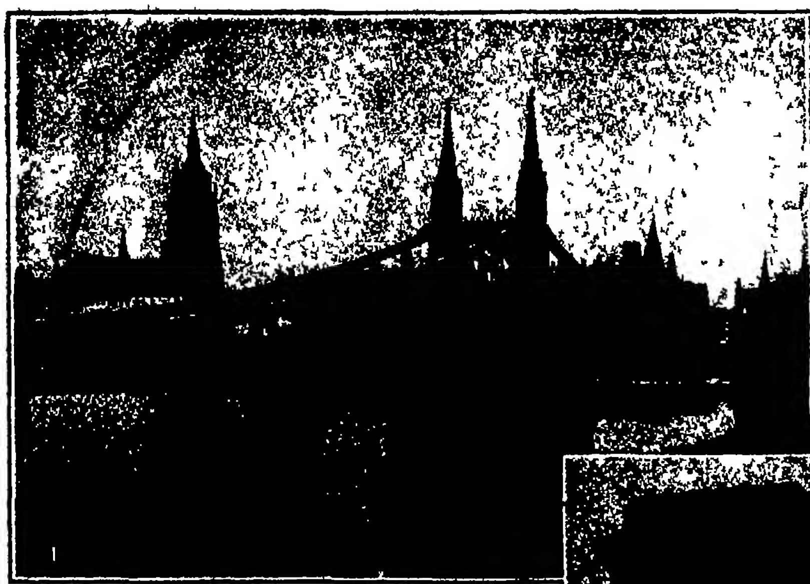
When iron came into use as a material for bridges about 150 years ago, it was a new material for architects. It gave birth to a new architecture, since it could be used to resist tension as well as pressure. It has obtained its most æsthetic value in the large suspension bridges built in the last one hundred years. Some elegant arch designs carrying streets and boulevards across the Seine in Paris were executed in cast iron. With iron and steel, larger spans than with stone became possible, and the way was open to a grander bridge architecture than was ever possible in stone.

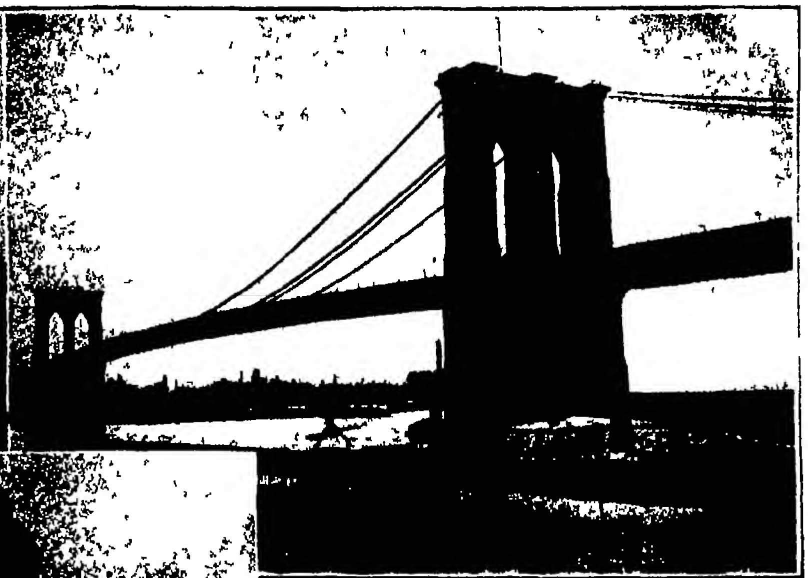
With the railroads came a sweeping change in transportation, in bridge construction, and also in bridge architecture. Today the desire for aesthetic structures is struggling with utilitarianism. Few only of the large iron railroad structures have a pleasing appearance. The great majority range from poverty-stricken simplicity to downright ugliness. The new material finds its best expression in the graceful curves of the suspension bridge, in the forms of the massive or latticed beam, and in the lofty and long-span arch.

The very rapid development of the technical sciences, including statics, led, it is true, to great precision and economy in the dimensioning of bridge structures, but, unfortunately, the fact was overlooked or ignored that iron and steel are subject to corrosion and are more perishable than stone. While stone bridges will endure for ages with little care, iron bridges require painting and continuous care to preserve them against the destructive elements in the air. And so it may come to pass that in the coming ages, say in the next 2,000 years, stone bridges, including the great Roman viaducts built in southern climates, where frost is not known, may still stand, with 4,000 years of life to their credit, as monuments of a past great civilization, while nothing may remain of the great iron and steel structures of the present day, but the stone piers and abutments, on which they were reared. Unless care is taken to build iron bridges in more durable form, and exercise continuous vigilance in their maintenance, they will surely be past their usefulness at some future time when our tall buildings of the skyscraper type, in which the steel frames are protected against corrosion, will still be giving good service to mankind.

The necessity of preserving large and costly iron and steel bridges against early decay should lead to a special type of protective architecture in bridges, as the same necessity has already done in the construction of steel-framed buildings. In fact, the beginning has already been made with smaller steel structures, by covering them with a coating of cement mortar.

The chain suspension bridge at Clifton, England, owes much of its beauty to the massive and appropriate masonry towers



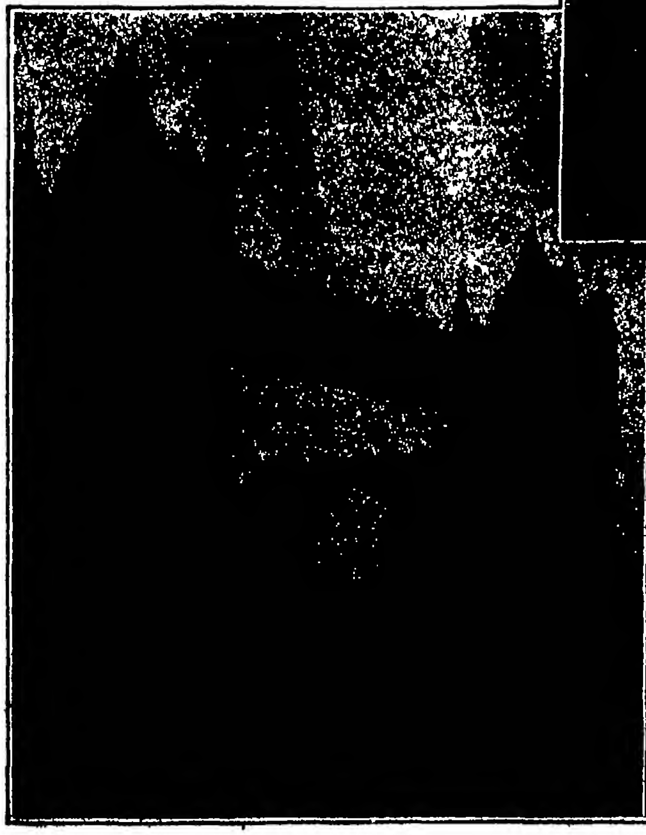


But this is a mere substitute for paint and does not promise a sure degree of durability, since the coating is liable to crack off. Pleasing architectural effects are not possible with such mongrel combinations, nor with the new material, "armored concrete," where it follows the lines of a framed steel or wood structure.

Concrete reinforced by steel offers great architectural possibilities for bridges. It is, indeed, the best material for masonry bridges of long span, but its most useful function in bridge construction should always be in the form in which the Romans, the inventors of concrete, used it, namely, in the form of an arch. With modern theory and resources, masonry arch bridges can be built of much longer spans than the Roman and Italian masterbuilders dared to use. Their longest span, built at the end of the fourteenth century over the Adda in Italy, attained a length of 251 feet. Concrete lends itself readily to moulded forms of decoration, although this can never attain that distinction which the stonecutter's art can produce in stone.

The architectural character of massiveness and power is obtainable to an unprecedented degree in iron and steel bridges of large size, and can further be enhanced by combination with great masonry abutments and towerlike piers. Such examples we have in the Menai Suspension Bridge (in Wales) with its massive stone towers supporting the heavy iron link chains from which the roadway is suspended, in the beautiful Buda pest Suspension Bridge and in the Brooklyn wire cable bridge. Fine examples of combinations of iron arches and impressive stone architecture are found among the bridges over the Rhine and Elbe in Germany, in the Hell Gate bridge over the East River and in the famous steel arch at St. Louis and the Washington arch bridge over the Harlem River.

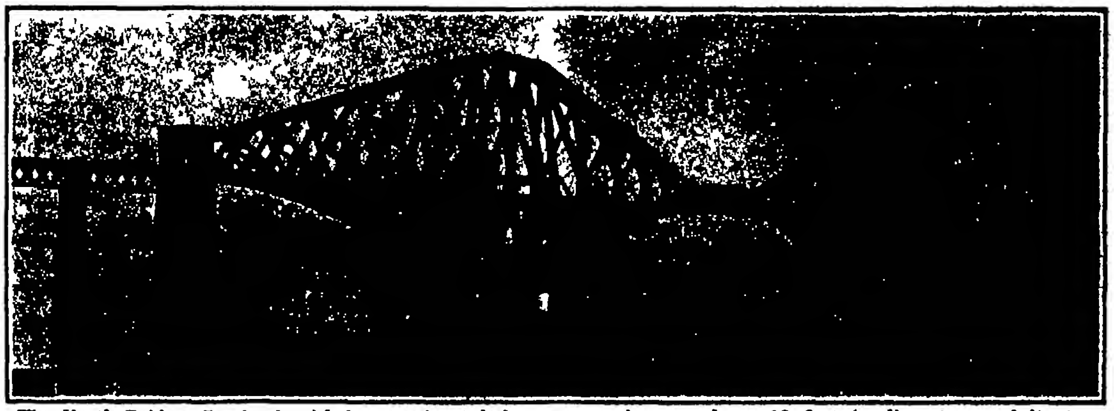
The majority of iron and steel bridges have, everywhere, been built for railroads. The much greater loads on railroads required heavier bridges than for mere highway traffic. Iron bridges, being susceptible of closer computation than stone bridges, were there-



1. The Gothic treatment of the towers of this beautiful cantilever bridge at Buda Pest harmonizes pleasingly with the Gothic churches of the city. 2. The Brooklyn Bridge is greatly admired for the simple and constructively appropriate design of its stone towers. 3. The mantle of stone which covers the towers (840 feet high) of the Hudson River Bridge, not only will protect the steel work, but will secure a satisfactory effect of mass and stability. 4. The masonry towers of the Tower Bridge, London, are designed to match the surrounding city architecture. 5. Note the fine architectural treatment of the anchorages and towers of this suspension bridge at Buda Pest

fore built with an exaggerated regard for economy, so that they provided only enough strength to carry safely the prescribed loads, in most cases without sufficient margin for future increase of loading. As the weight of trains increased, large, costly bridges were found too weak and had to be replaced with structures of greater strength, but even then, no greater margin of strength was provided for a further increase of loads under the necessities of traffic These cheese-paring economies have become very costly on all railroads. Because of this lamentable want of foresight, already, on several American railroads there have been four generations of metal bridges. Meanwhile, stone arch bridges have required no such rebuilding The many thousand metal highway bridges throughout the country are of the same character In almost all such cases there was and is no thought of architecture, or of durability, or of pride in the art. In the fierce commercial competition, the most naked utilitarian considerations are allowed to govern the design for such structures.

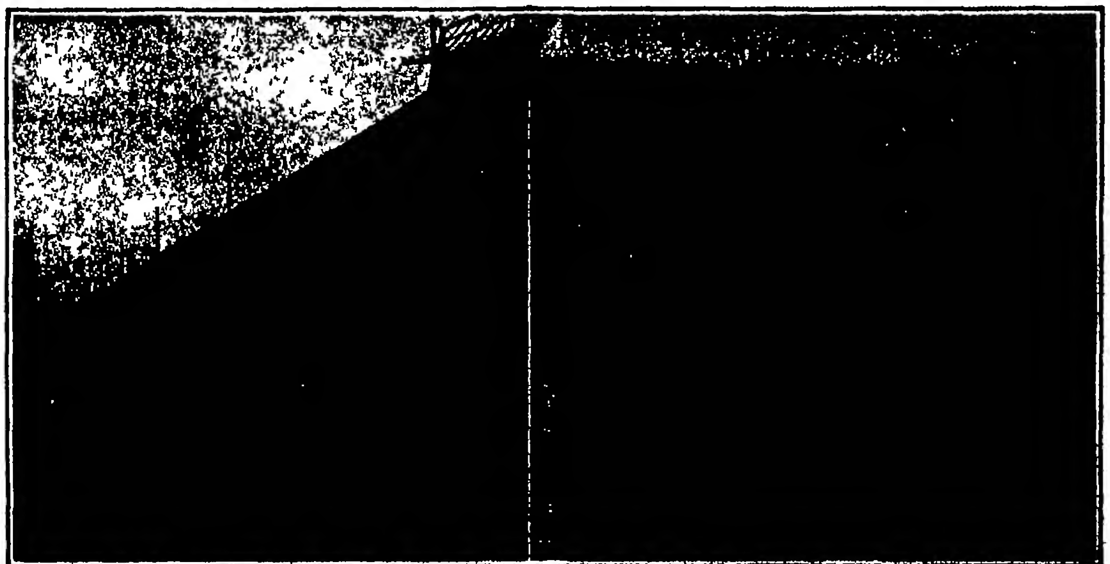
The art of steel bridge building, in the great majority of cases, has thus become a commercialized trade which has been prostituted, under the pretense of scientific economy, to the production of the cheapest structures that will carry the loads. Even so, we witnessed a few years ago the collapse, merely under its own load, of one of the greatest cantilever bridges ever attempted



The Forth Bridge, Scotland, with its massive tubular compression members, 12 feet in diameter, and its two 1710-*foot main spans, gives an impression of strength and permanence*

As a matter of fact, supposing that two bridges for, let us say, a river crossing are designed with equal strength, *one of them with the strictest regard for* economy and the other designed not only with regard to economy but also with an eye to its fine architectural appearance, it will be found that the cost of giving beauty and dignity to the bridge is insignificant compared with the total cost of the whole structure

Of late years, engineers have increasingly realized the necessity of providing for the durability of their bridges by encasing their steelwork, as far as possible, in masonry or other non erodible material A notable case of *this is* the Tower Bascule Bridge across the Thames, London. Here, not only was an outer wall of protective masonry built around the main steel towers, but this masonry was designed to harmonize with the architecture of the immediate *surroundings* of the bridge The result, from the architectural standpoint, is highly successful, and the Gothic towers harmonize pleasingly with the suspension trusses, the roadways and the bascule portions of the main floor. If care is taken in painting as much of the steelwork of this bridge as is exposed, there is no reason why its life should not run into the thousands of years.



Left The famous Eads steel arch bridge at St. Louis, a handsome design with appropriate masonry piers and abutments. *Right:* Beautiful arch roadway bridge of 840-foot span across the Niagara River

The latest notable recognition of the call for permanence in costly bridge structures, and for architectural effects which will express the main constructional feature of a bridge, is the North River Bridge across the Hudson River, New York, which, because of its vast *size and monumental character, to say nothing of its* urgent utility in the transportation problem of the metropolis—calls loudly both for architectural dignity and the assurance of permanent life

The principal elements in this structure are the cables and the towers. The preservation of these will be met by encasing the cables in continuous bronze or copper tubes impervious to the weather, and in the case of the towers by clothing them with walls of masonry throughout their entire height. The huge anchorages, 400 feet square by over 200 feet high, are built of masonry by necessity, in order to secure the needed mass. The skeleton steel towers, were they not clothed in masonry, would look to any but the eye of an engineer entirely too frail, and lacking in dignity for the important duty they have to perform. Considerations of permanence and architectural nobility are the motives which have prompted the clothing of these huge towers in their mantles of enduring granite.

A New Theory of Flight

A GERMAN inventor, Gustav Lilienthal, has been studying for some years the wing structure of large birds, the frigate bird being taken as a type. He remarks "Since the bird without any expenditure of energy not only lifts its own weight but is also still driven forward, it seems certain that if we can discover the source of the energy by which this is accomplished, we shall have gained information very useful with respect to the driving of air craft By means of the propeller *the motor creates an exclusively forward drive* to overcome the backward pressure acting upon the airplane. These pressures are produced by the combination of the head resistance of the body of the craft and the rearward slanting pressure of the lifting impulse beneath the wings. If we could find a way to eliminate these resistances, we should at once be able to lower the required power of the motor"

Countless experiments and observations extending over a period of many years, into whose details we cannot well go, led Lilienthal to construct an artificial plane having a cross section similar to the middle part of that of the wing of a frigate bird. The plane was first placed in a room carefully protected from external air currents and set in rapid motion, *the direction of* the currents thus produced being shown by small pennants placed on the upper and the lower sides of the frame. On the upper side of the plane the current of air followed the curvature of the profile exactly, whereas on the under side of the plane a vortex was produced, in such a manner that the air flowed along the under side of the plane *from back to front* whereupon the spirals of the vortex wound themselves outward like the horns of a ram and flowed off right and left into the surrounding air of the carefully closed room.

From a study of the longitudinal profile of the frigate bird it can very readily be seen that the portions of the wing adjacent to the middle portion of the wing from the "shoulder" to the "elbow" and from the "wrist" to the tip have an oblique direction with respect to the lateral current. Because of this fact the kite principle comes into operation and an upward impulse is created.

Lilienthal next built a *new model* representing an entire bird and imitating the longitudinal profile of the frigate bird wing. In this the motion of the pennants showed that the vortex of air slowed off toward the body and toward the tips. Especially toward the tips the current of air was so strong that even at the ends the pennants flew out in the longitudinal direction of the wings. In other words, *directly-cross-wise.* The direction of the pressure of the air resistance upon the root and the tip of the wing is therefore no longer slantwise toward the rear, but rotated at a right angle in the longitudinal direction of the wind Hence there is no longer resistant *direction of* force, but only the buoyant impulse. In the middle of the wing where the current of air presses strongly against the downward bent forward edge of the wing, the direction of the pressure is inclined forward At this point the driving impulse is entirely forward. On the upper surface of the wing a suction begins to be exerted, but the direction of this lifting force cannot be exactly determined. He next exposed his models to fresh sea breezes.

As he had expected, his planes and models were subjected to a remarkably strong upward drive—so that not only the head resistance of the forward edge was overcome, but the freely movable experimental planes were moved in front of the plumb line. The excess of the forward impulse over the head resistance needs be but slight, since it produces a constant acceleration. The largest model had a wing surface of 80 sq. m. It was observed in these large models that there was a backward bow of air under the tail also. In the case of real birds this current of air strikes the soft plumage of the body and thus overcomes the head resistance of the latter.

The experimenter concludes that when the wind lacks the "friction *buoyancy" birds are as* unable to soar as they are in a dead calm, even if the bird had acquired a great forward velocity by means of beating its wings and volplaning, it would still be unable to soar. In both cases it would lack the source of energy given by the buoyant impulse without which source no work could be done.

Lilienthal does not hesitate to declare that the large model he has built, for which we are indebted to *Kosmos* (Stuttgart) for April, 1921, is destined to be the form of the future airplane.

Bitumen in Palestine

BITUMEN is gathered in Palestine from the Dead Sea, where it is found floating on the surface of the sea. Prior to the war this bitumen was gathered and turned over to an American, who lived in Jerusalem, who in turn exported it by special permit. It is said that the annual export amounted to approximately 50 tons, and that practically the entire output was sent to Germany, where it was used in preparing the gloss for patent leather. At present very little of this bitumen is being gathered.

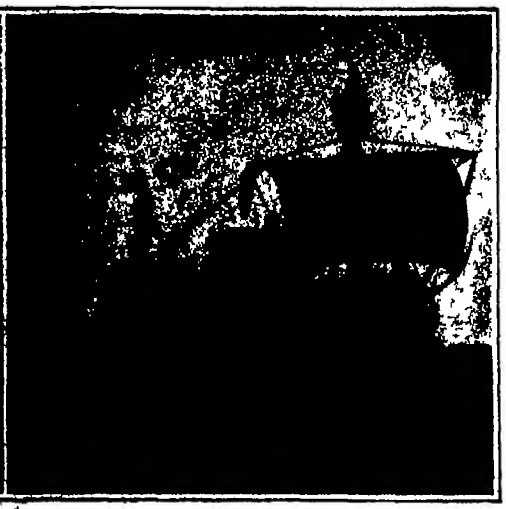
From Trireme to Dreadnought

The Development of the Warship from Ancient to Modern Times

By J. Bernard Walker

IT is not possible to name any definite date or even period when the warship, even in its most crude form, came into existence. It is probable that from the earliest days the mariner found it advisable to carry with him arms for defense, for we know that even centuries before the Christian era, those wonderful sea traders, the Phoenicians, were armed sufficiently to protect themselves against the pirates that infested the trading routes of those days. The development of the warship is necessarily associated with the development of the merchant ship. In fact, the one grew out of the other. The difference between the two was that, whereas the merchant ship relied principally upon its sail power, the warship depended principally for speed and maneuvering ability upon its oarsmen.

Greek warship of the days of the Salamis battle



Typical Roman Trireme of the Punic Wars

Our earliest record of sailing ships is to be found upon those wonderful historical sculptures, engravings and paintings with which the ruins of ancient Egypt abound.

Egyptian seamanship, however, was confined almost entirely to the navigation of the Nile, and it was not often that their vessels ventured beyond the Nile delta into the waters of the Mediterranean. To them, however, must be credited the familiar form of the ancient ship, with its curving prow and lofty stern, and with its long bank of rowers. This form persevered for some 3000 to 4000 years, and may be seen (of course greatly modified) in the ships of the Greeks, Romans and the Venetians.

The first great race of seamen was undoubtedly the Phoenicians, whose enterprise carried them throughout the full length of the Mediterranean and ultimately through the Straits of Gibraltar and to the coasts of Britain.

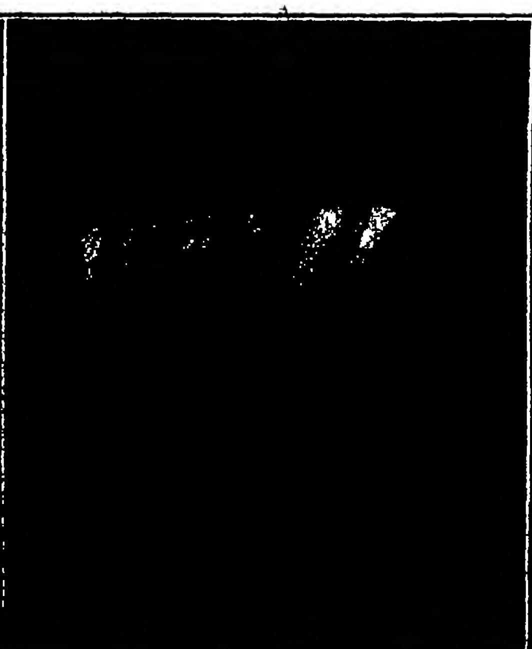
We know from the Syrian sculptures that the Phoenicians, as early as 700 B.C., were building biremes, with two banks of oars, and that their vessels must have been seaworthy and themselves great navigators for those early days, is shown by Herodotus, who records that Neco, king of Egypt, failing to build a canal from the Mediterranean to the Red Sea, sent a crew of Phoenicians on a voyage around Africa, which, wonderful to relate, they succeeded in accomplishing, leaving from the Red Sea and coming back through the Mediterranean.

It is probable that the Greeks modelled their earlier ships after those of the Phoenicians, and we present an illustration of the type of Greek warship which took part in the battle of Salamis. The meager records of history fail to tell us just when it was that the ship followed in its structure that of the skeleton of the fish, with backbone and ribs, but we know that the Greek ship was provided with keel and ribs to which latter the ship's planking was fastened by means of tree-nails or pegs of wood. There was also a certain amount of use made of bronze nails. A single mast with one square sail was used, and this was characteristic of the early warships for many centuries. Homer tells us that the Greek warship was manned by from twenty to fifty rowers, who sat upon transverse seats or thwarts. There was a cabin forward and another aft. On the forward cabin deck was the lookout, and at the stern of the after cabin was the helmsman, the Greek ship having two steering oars, one on each side of the stern post, which were connected by a cross bar to which was attached the tiller. The stern of the ship was carried up in a huge sweeping, ornamental tail. Up to the year 700 B.C., the largest ships contained fifty rowers, arranged in a single bank, but later an upper deck was added and a second bank of oars, such ships being known as biremes, and this was succeeded by ships with triple banks of oars known as triremes, of which no less than one hundred were used at the battle of Salamis. An invariable feature found on all warships was the ram, which consisted of a massive projecting spur below water level, and another ram-like arrangement to strike the ship between wind and water. Ramming was the principal tactic employed in ancient sea fighting, and it sometimes happened that the attacking boat suffered only less severely than the enemy.

As the Greeks followed the Phoenicians, so did the Romans the Greeks, each developing and enlarging the ships of predecessors. The Romans are principally to be remembered for the development of their merchant marine with its famous corn ships, which brought the produce of distant Mediterranean countries to Rome. In Roman history, as with the British Empire, the Roman merchant marine was the great bond between the imperial seat of power and the outlying provinces. Lucian has left a most fascinating description of his visit to one of these ships, and he speaks of the ship's cabins, of the sailors, mounting the lofty masts by the ropes and running out along the yards. Forward he notes the prow bearing the ship's name, and aft, the vessel sweeping up into a gilded goose-neck. He speaks of the capstan and the windlass, and finally, of the captain, "an honest fellow, bald-pated, with a fringe of curly hair." It should interest us here in America to know that the early Romans extemporized their fighting fleets, and that they set about their preparation only at the approach of war. Later, however, Rome was provided with decks, but it was not until the Punic War that this great military people appreciated the need for a navy. We know that the Romans defeated the Carthaginians with a fleet of one hundred quinquiremes and twenty triremes—that is, vessels with five and three banks of oars.

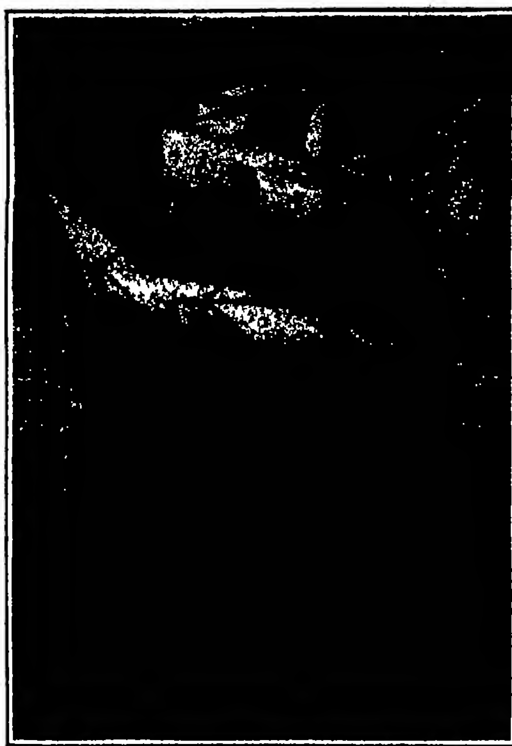
The first warships of all early nations were undecked, open boats. Then came the erection of forward and after enclosed structures, corresponding to the forecastle and poop, and following that, or contemporaneously with it, a central gallery or platform connected the two deck structures, for the use of the captain and other officials. Then as ships increased in size, they became completely decked, and upon the deck of the

Venetian galley of the Middle Ages

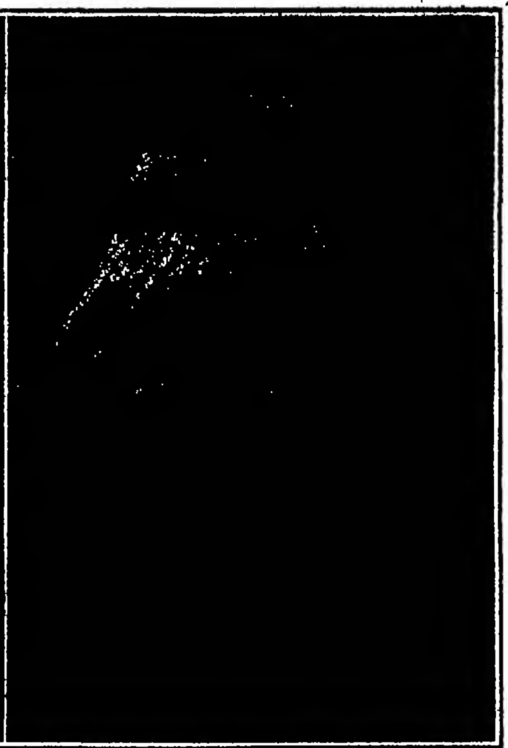


One of the dreaded Viking craft

French warship, middle 14th century



Spanish two-decker of the Armada, 1588



The "Victory" of Nelson's day—a three-decker

fighting galley the troops were stationed, the rowers being below deck The Roman galleys grew to formidable size The single forward mast with a fighting top was retained, but for speed and power reliance was placed upon the oarsmen, the banks of oars being increased from the original single bank up to as many as five. There has been a hot discussion among the students of ancient warship construction as to whether the oarsmen were placed in successive tiers above one another, or whether they were not arranged on one deck with each two, three or more sets of oars operated through the same porthole, the oars being of different length to enable the rowers to clear each other The argument in favor of the super-position of the banks of oarsmen is stronger, and certainly more agreeable to the pictorial records that have come down from ancient times.

Limitations of space forbid more than a passing reference to our illustration of a typical Venetian galley The Venetians had a notable share in the development of both the merchant and the warship in early and mediæval times in the Mediterranean. We notice that the famous lateen sail which is still a favorite type in Mediterranean waters, was conspicuous on the Venetian galleys. The vessel shown is three-masted, and it marks a considerable advance in sail power over the earlier types of which mention has been made above The advantage of using longer oars led to the adoption of an outrigger frame-work which was a continuous structure, running the full length of the ship in the wake of the oars Ultimately, this was provided with outer bulwarks for the protection of the rowers and the fighting men. The galley has always held a conspicuous place in the annals of naval warfare, particularly of naval development, and the Venetian galleys were justly famous in their day Even in modern times the genius of Italian naval construction has left a profound impress upon both the ships and the fighting material of our modern navies.

We have spoken of the Phoenicians as holding a high place both in navigation and seamanship among the ancient maritime peoples but we think that even they must yield pride of place to the Scandinavians, than whom a more daring, robust and capable race of seamen has never existed. Unlike the cumbersome boats of their contemporaries, the ships of the Viking mariners were built with fair, easy lines, and with a splendid sheer, which carried bow and stern well above the reach of breaking seas. Not only did they navigate their own coasts, but the Vikings did not hesitate to reach out into the unexplored ocean to the westward, and it is now generally accepted that the Vikings landed in America several hundred years before Columbus himself. How they did their navigation, it is impossible to tell The sun by day and the pole star by night and a certain fine instinct for the sea were about all that they had to depend upon. That such open craft as the Viking boats could outlive the Atlantic gales was proved during the time of the Chicago exposition, when a boat modelled after the remains of a Viking boat which had been discovered in a burial mound in Norway was sailed across the Atlantic for exposition at the Chicago fair. Leaving Bergen on May first, she reached Newport, Rhode Island, on June 13th. The captain stated that the "Viking" had proved herself to be an excellent sea boat, and that under her square sail to which a flying jib was added, she was able to make a speed that compared well with that of modern merchant vessels. The Vikings were a hardy race, and they never appeared to have made any effort to house in their boats, which were always long, lean, open and probably the fastest vessels afloat in their day The rowers sat on thwarts, and, indeed, the vessel was in many respects similar to the open lifeboat of modern times. For shelter they used a pair of crutches with a ridge pole laid between, over which canvas was stretched, and the boat was steered by a rudder which was carried on the starboard side

Our illustration showing a French warship of 1352 marks the closing of the period when ships were propelled by a combination of oars and sails, and when the fighting was done at close range by archers and crossbowmen, or by means of stones and weights thrown from crossbows and catapults, or hurled from the fighting tops. This curious vessel shows a bowsprit rising from a forward fighting platform, and aft we note the genesis of that lofty poop, which was destined to be a characteristic feature of warships of the Spanish Ar- fighting with artillery which was just about to open.

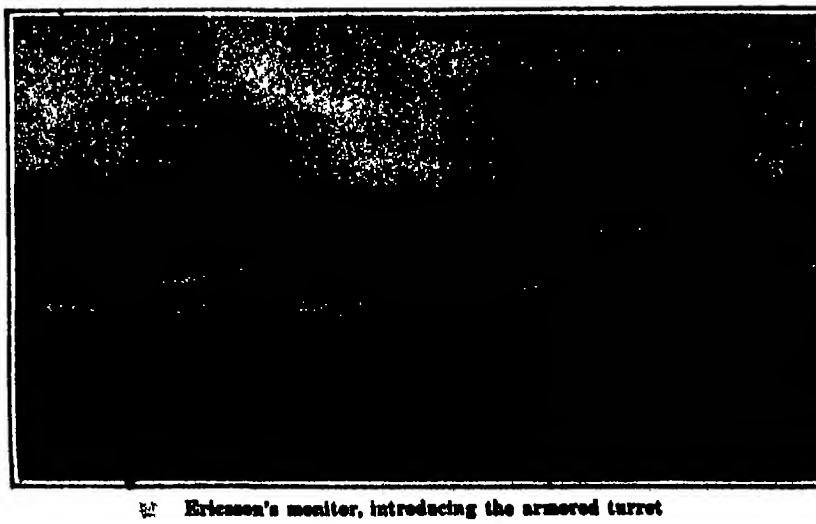
The next illustration in order is that of one of the ships of the Spanish Armada, which sailed toward the close of the sixteenth century. Here we note, as compared with the French vessel of the middle of the 14th century, that a third mast has been added and that the fore and main masts have grown in height until they carry topsails and even to'-gallant sails. The crude cannon of that day of low power and short range are carried on two decks, and it will be noted that the above water ramming stem head of the early days of the warship still survives in the huge stem piece with its super-incumbent dragon.

Once the oar had given place to the sail, and the bow and arrow to the gun, the line of development was obvious, and ships of the seventeenth and eighteenth century grew steadily in size and sail power until they reached the great three-deckers of the Nelson period. The largest of these craft carried as many as 120 to 130 guns. One of our illustrations shows the "Victory," Nelson's flagship at the battle of Trafalgar, as she must have appeared when under sail.

The wooden sailing ship held its own until the second half of the nineteenth century The first radical change began with the introduction of steam as an auxiliary to sail power, and the steam frigates of which our own "Hartford" is a conspicuous example, held sway as the most formidable type of fighting ships for many years, and figured largely in the naval operations of our Civil War

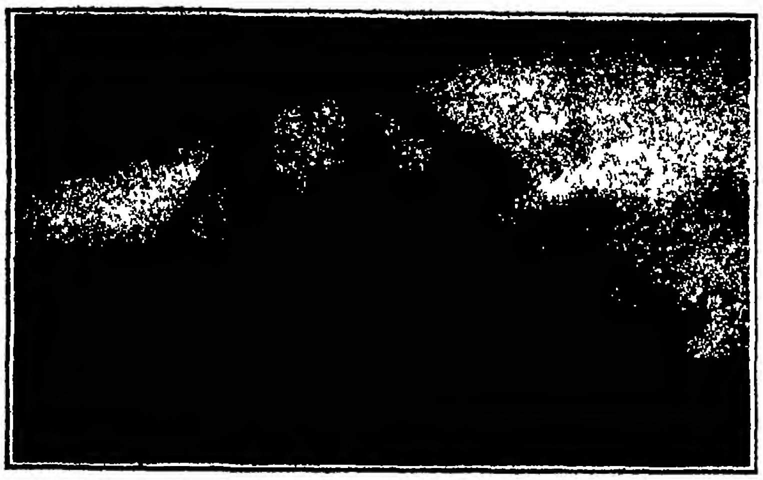
Too much stress cannot be laid upon the introduction by Ericsson of the monitor—a vessel of steel with a low freeboard of a foot or two, with nothing above deck but a single armored turret with a couple of heavy guns. A few years before the appearance of the monitor, the French had plated the sides of their steam frigates with iron, and it is the ultimate plating of the monitor and the iron-plated frigate, together with the development in naval marine engines and the power of the gun, that led up to the development of the modern armor-plated battleship, a notable example of which is our own "Oregon." In this ship we have the heavy, 18-inch side armor plate, the heavily plated turret, and the guns carried entirely behind armor The freeboard has been raised to 13 feet, in order to give seaworthiness. This brings us to the year 1895.

The final step in the development of the fighting ship was the introduction by the British of the dreadnought, in which the mixed battery of 12-inch, 8-inch and 6-inch guns was abandoned, and a single caliber of 12 inches

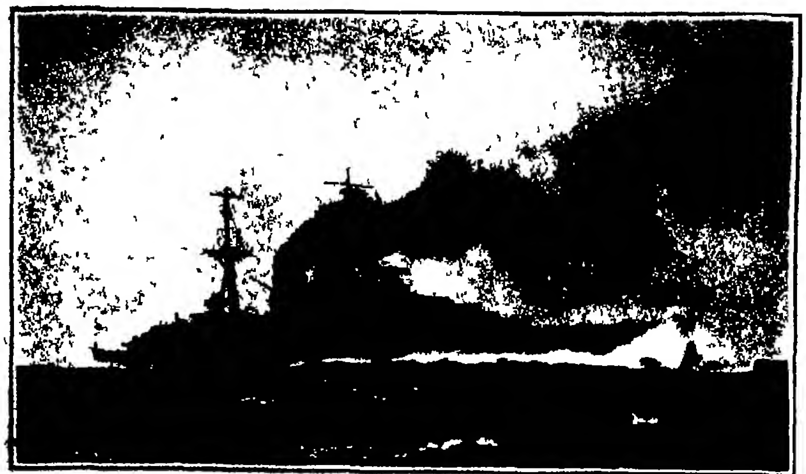


Ericsson's monitor, introducing the armored turret

Battleship "Oregon"; moderate freeboard and heavy armor



The dreadnought "Pennsylvania," 32,000 tons; speed 21 knots; 13"-18" armor; Twelve 14" guns



The battle-cruiser "Hood"; 42,000 tons. Speed on trial, as pictured here, 32 knots, 12"-15" armor, eight 15" guns

was substituted, with a few small anti-torpedo-boat guns. The Dreadnought was a ship of about 17,500 tons displacement, 21 knots speed, 11 inches of armor, and she mounted ten 12-inch guns. From that time on the development has been in the direction of increasing the caliber of the gun, thickening the armor and increasing the steaming radius, and providing cellular compartments along the sides as a protection against the submarine. The "Pennsylvania" may be taken as a good example of the highest development of the modern fighting ship. She carries twelve 14-inch guns behind 18 inches of armor, and is protected by 13½ inches of armor at the water line. Her speed is 21 knots.

A new type has been developed by the British during the war which may or may not become permanent, and this is the "Hood," a vessel 860 feet in length over-all, of 42,000 tons displacement and mounting eight 15-inch guns, the ship being protected by twelve inches of face-hardened armor. A remarkable feature about this vessel is the fact that this heavy gun power, armor protection and great size are associated with a speed of 32 knots.

A New Engine Fuel

At the meeting of the Society of German Chemists recently held at Stuttgart, Dr. Schrauth, private lecturer at the University of Berlin, made an interesting communication on a remarkable new engine fuel derived from naphthaline. German engineers are, under present economical conditions, anxious to find new sources of engine fuel in the home supply of raw materials. Though the use of naphthaline had even in pre-war times been suggested, endeavors made in this connection had so far failed to give any positive results on account of the high melting point of that material, solid at ordinary temperatures, as well as of the complicated preheating devices required to melt and gasify it.

According to the new process made known at the meeting, naphthaline is by chemical means converted into a new liquid compound, bearing the somewhat comprehensive name of Tetra-hydronaphthaline, but termed Tetraline for the sake of shortness, which has proved to be a surprisingly satisfactory engine fuel.

The new fuel is a liquid clear as water, of the specific weight .975, having its boiling point at 205 deg. Cent. and the constancy of which at low temperatures, on account of its low freezing point (-30 deg. Cent.), compares favorably with that of benzol. The high boiling point and a flash point lying at 78 deg. Cent. make tetraline an especially desirable fuel for the high-compression internal compression engines constituting the ultimate goal of present tendencies in engine construction, its high heating value (11,000 calories/kg. as a minimum) insuring a remarkably high output in a limited space, such as neither gasoline nor benzol would allow.

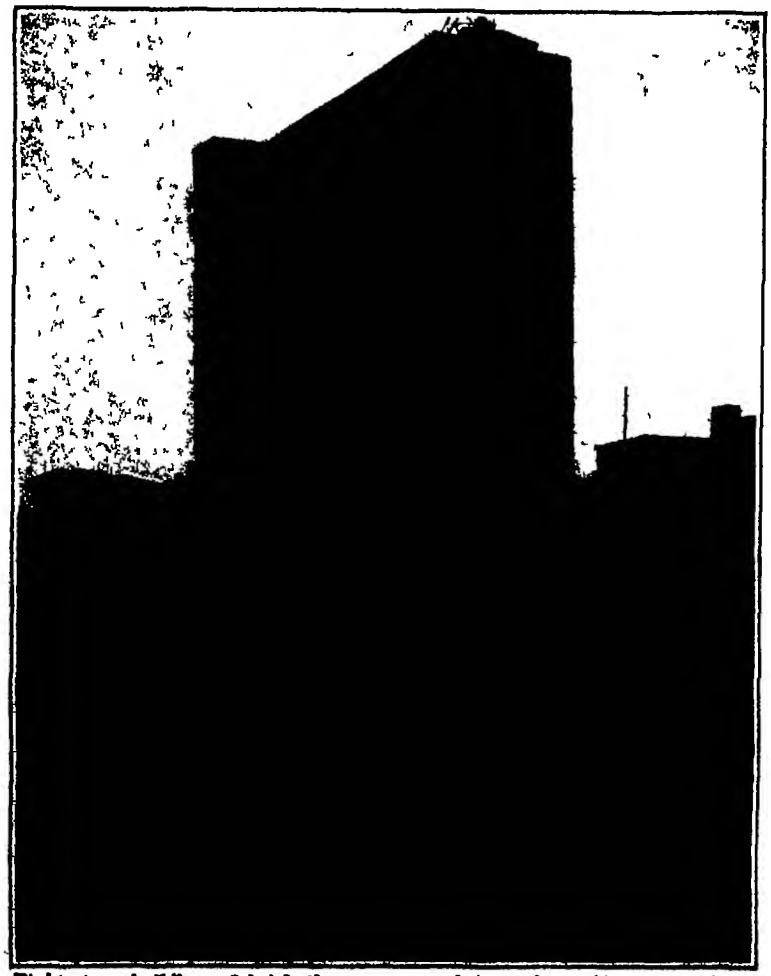
However, tetraline can as well be used in present engine types designed for petrol and gasoline operation, by mixing it with materials boiling at lower temperatures, and thus securing a ready starting, ease of control and smooth running of the engine. Thanks to an addition of gasoline, the specific weight of tetraline is reduced to a figure intermediary between those of engine gasoline and benzol, thus doing away with the necessity of any material alteration of existing carburetors.

Comprehensive tests at the Internal Combustion Engine and Motor Car Testing Laboratory of the Berlin Technical High School have shown a mixture of 1 part by weight of tetraline and 1 part by weight of the usual engine gasoline to give the most satisfactory results (approximately equivalent to those obtainable with benzol). When lighter gasoline is used, the percentage of tetraline can be augmented thus insuring even better performances. Similar results are observed when using benzol in the place of gasoline as additional fuel, when apart from the advantages above referred to (especially an extreme ease of starting), a greater increase of energy in the fuel tank is obtained.

The well known expert Wa. Ostwald, has made extensive tests on such tetraline-benzol mixtures, about which he writes as follows: "A mixture of equal parts of tetraline and benzol constitutes a remarkably good engine fuel, readily starting and burning without any hitch. No alteration of existing nozzles is required. The fuel has a high energy capacity, yielding a high number of kilometers per liter. No difficulties of any kind have been experienced."—*By Dr. A. Gradenwitz.*

Business as Usual While Moving

Within a comparatively short space memory can carry us back to a time when a house-moving job of any sort was an undertaking of considerable note. Today the ordinary dwelling is shunted about from one place to another, moved across half the town, turned around, and otherwise treated as though its transportability were equal to that of the big truck that does the hauling.

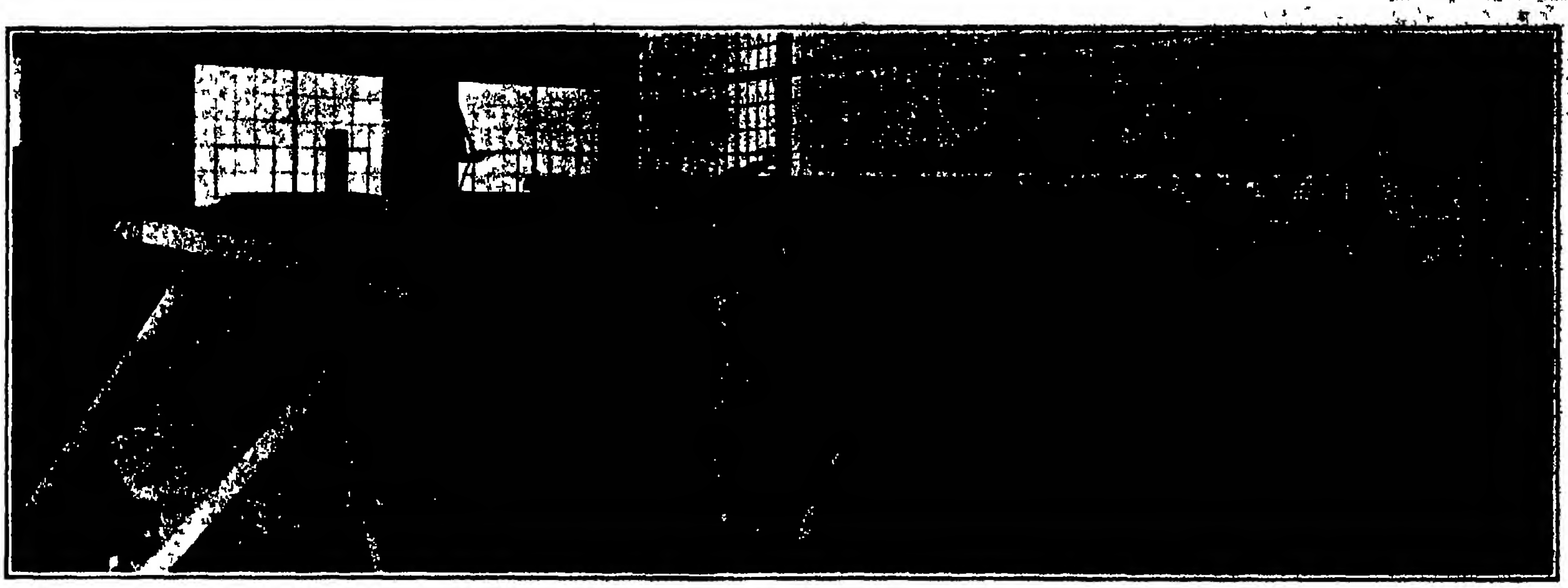


Eight-story building of brick that was moved forty feet, sidewalks and all, without any interruption to the business

The only possible kind of house-moving undertaking that gets anybody excited in the present generation is one that our fathers would have branded, without argument, as utterly impossible.

One of the most ticklish jobs of the sort we have seen is illustrated on this page. The brick building is always the bane of the house-mover—there are so many places where it can break apart, so many different courses that a dangerous crack, once started, may pursue. Nevertheless, brick buildings are moved with considerable confidence—as the picture shows. This structure was in the swath that was being cleared in connection with the widening of Second Ave., Pittsburgh. It was eight stories high, and it housed a busy business. It was decided to save the building by shunting it back forty feet on to a new site. But what of the business? Logically it might seem that this ought to move out pending the shifting of the building. But there was no place to move to, so it was decided to move the business along with the building. So that was the arrangement made with the contractor—and at every moment of the long-drawn-out moving job the offices and storerooms in the structure were on a basis of "business as usual."

Gas, water, sewer, electric light, steam heat and power for the elevator, and telephone connections were maintained at all times. An elevator running in a moving building is perhaps something really new under the sun. Another curious feature was that the reinforced concrete sidewalks, being part of the building and necessary to cover the cellar extension under the new site as well as under the old, were supported by beams attached to the steel frame of the building and moved along with the rest of the establishment. The building was raised twelve inches, moved forty feet, and deposited on its new foundations without a hitch. The feat attracted no little attention in Pittsburgh, the crowds making the task still more difficult.



Structurally, the American airplane is as safe as it is humanly possible to make a flying machine. Its wings are tested with sand bags, as shown in this view, so as to apply a load or strain many times that encountered in all kinds of flying. The factor of safety runs very high

Can the Airplane Be Made Safe?

Why Airplane Fatalities Take Place and What Is Being Done to Make Flying Safe

By Harry A. Mount

THE biggest and most important problem confronting the pioneers in commercial aviation is to make flying safe. For, in spite of all that has been said and done to prove the contrary fact, flying today is not safe. This statement, however, needs to be qualified, for the term "safe" is a relative one.

A number of disastrous accidents have taken place in the past few months, as we all know. And these selfsame accidents have served, perhaps more than any thing that has yet occurred, to warn the layman of the dangers of flight. The owner of six flying fields from which hundreds of passengers weekly have been carried on aerial sight-seeing trips, is authority for the statement that these fields and others have been practically deserted in the past few months, so profound has been the effect of these accidents on the average individual.

Now no known method of transportation is absolutely safe, whether by rail, by boat, or by automobile. A man takes a chance with life and limb when he steps on board a street car. But the chance of accident is so small that he rarely gives the matter a thought.

Admittedly, flying is dangerous, but just how dangerous? Probably the extent of the danger is exaggerated in the popular mind. A statement recently issued by the Manufacturers Aircraft Association, covering the period of six months ending July 1—and this includes part of the recent series of serious accidents—showed that the 1200 commercial aircraft operating in the United States flew approximately 3,250,000 miles, and that as a result fifteen persons were killed and 48 were injured in 27 serious accidents. Eight of the fatalities and 32 of the injuries the statement blames on lack of terminal facilities, of air routes, and of storm warnings, or to reckless stunt flying—all of which could have been prevented had there been a national air policy. Deducting these preventable casualties, there was one death for each 404,285 miles flown and one injury for each 205,454 miles flown.

Yet that is not safe enough. It means that in making a trip of a hundred miles by plane a man takes a chance of less than one in 500 that he will not arrive at his destination alive, and double that chance that he will be injured. It means that of every five hundred passengers (or less) carried, one will be killed and two injured. If the railroads maintained any such casualty rate, they would kill off their entire force of engineers every few months. The airplane must compete with the railroads in the commercial field, and to do so successfully a trip by air must approach the degree of safety that the railroad affords.

Happily, a critical review of the facts upon which the figures quoted above are based shows that they make the worst of a bad situation. Of the 1200 aircraft included in the report, about 1000 are operated under the supervision of responsible manufacturers or transportation companies. The other 200 come under the classification of "gypsy flyers." Many of the planes operated by responsible organizations and practically all of the "gypsy flyers" are war machines converted to commercial purposes. They are not as safe as it is possible to build planes today. Most of the accidents have occurred among the two hundred "gypsy flyers."

The risk to aircraft arises from three main sources, and the preventive work being done is following the three broad channels these suggest, viz. first, the construction and air-worthiness of the craft; second, the operating personnel; and third, the landing facilities and organization.

The first is a problem for the manufacturer, for it concerns the mechanism itself. So high a factor of safety is maintained by all the large airplane makers in this country and so far has the science of design progressed, that any up-to-date standard make of plane, given proper care and inspection, may be depended upon absolutely not to fail in the air. This, of course, does not apply to rebuilt war machines or those which are not properly cared for in their regular service.

In the matter of motors, however, there is a very different situation. The motor is the "sore spot" of the machine, mechanically. Present-day aviation motors are wonders in reliability compared to those in use a few years ago, but the best of them still are unreliable. A pilot can never tell when his motor is going to "quit on him," and he never feels entirely safe, therefore, unless he is within gliding distance of a landing field. The difficulty seems to be that the high speed internal combustion engine is basically unreliable. There are a large number of rapidly moving parts, some exposed to very high temperatures, which cannot be dispensed with, and there is always the danger of failure in one of these parts which will put the motor out of commission.

Two things are being done to lessen this danger. Motors are being built heavier than the war motors. This does not mean, however, that the machines are less efficient, for so far it has been possible to make a corresponding saving in weight in the airplane. The danger of motor failure is lessened in a large plane by a multiplicity of motors. Most of the two-motored ships are able to fly with one motor "dead." There are also under experiment various schemes for gearing several motors to a single propeller, so that one or more of the motors can be operated at one time while others are held idle as a reserve. The added weight and unreliability of gears, however, has been against this scheme. Two manufacturers have expressed the hope to the writer that the steam engine can be brought to a state of perfection so that it can replace the internal combustion engine on aircraft. There is said to be at least one promising experiment along this line being conducted in this country.

Of safety devices only one holds promise that it will add much to the safety of air passengers, and that is the parachute. Perhaps the average man does not relish the idea of stepping off into space with a little silken bag to save his life. But, as a last resort, he would do it, and the chances that he will live to tell of his experience are greater by far than if he were dropped in the middle of the Atlantic from a sinking ship with a life preserver about him.

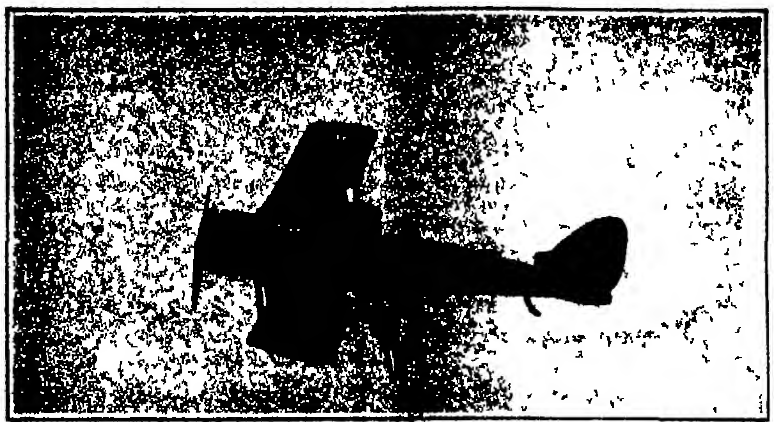
Stabilizers have been developed so that they can fly a machine on a straight line without aid from the pilot. But this is merely an aid to the flyer rather than a safety device. For if the pilot is incapacitated in the air there is no way to land safely, even though the machine may be kept in the air safely for a time.

The element of risk from inefficient per-

The parachute is to the aviator of today what the life preserver is to the marine traveler. And the chances of safety with the parachute are many times greater than those with a life preserver

sonnel is not important. Accidents rarely happen because the flyer or his assistants are incompetent. The fact that many accidents happen because the pilot takes foolish chances ought rather to be attributed to the third source of risk—to defects in organization.

It is in this third class of risks—landing fields and organization—that there is room for great improvement and in which there is the promise of quick results. The development of landing fields will of course be slow—just as slow as the development of commercial aviation. In all the United States there are now only 214 adequate municipal or civilian air ports, yet terminals are as necessary to aerial transportation as they are to shipping or railways. Every added flying field is an added factor of safety to commercial aviation. It reduces the chance that in an emergency a plane will have to land in a fence corner or a highway.



The parachute has done much to make flying safer. While it is not the most pleasant sensation to step out into space and depend on a little silk bag, it is better than being dashed to death

So far, this country has lagged behind all other important nations, in failing to provide national air laws. Those few States or communities which have attempted local legislation on the subject have found it difficult or impossible to enforce their regulations.

There has been no way to stop such dangerous practices as flying unsafe machines, flying without the pilot having proper training, flying over crowds, dangerous stunting with passengers, and so on.

In a recent conference with Secretary of Commerce Hoover, representatives of commercial and civil aviation received the definite assurance that a law providing a registration system and a code of air traffic laws would be drawn and presented to Congress at the first opportunity.

A second step in this direction, and a very important one, has just been taken by the Underwriters' Laboratories. The actual and prospective developments in the use of aircraft in transportation of both freight and passengers have created a demand for insurance protection for the capital invested. This demand is now being met by certain insurance companies, and the organization of aircraft departments is being seriously considered by others, for it is foreseen that aircraft insurance will become of large importance.

Analysis of the problems encountered by the aircraft underwriter has been undertaken by the Underwriters' Laboratories under the supervision of Vice-President A. R. Small. The importance of this development lies in the fact that Mr. Small and his associates have devised a registration scheme for both pilots and aircraft and presumably no airplane can now be insured until the rules laid down under this registration system have been complied with.

It is expected this system will prevent the issuance of insurance on a craft unsafe mechanically, which is driven by a pilot not fully qualified, or which is subject to too great risk from any other cause. An airplane is too costly to operate on a commercial scale without insurance and it is believed this step will have the effect of materially reducing the chances of accident and therefore the number of accidents. In Europe commercial aviation is heavily subsidized by the governments, while in this country it must "stand on its own legs" and must pay its own way. This makes the stand of the insurance companies doubly effective.

In closing it ought to be noted that one of the largest benefits to be derived from such cooperative enterprises will be from a system of weather signals, and instructions to flyers while in the air, which have been rendered possible through the development of the directional wireless and the wireless telephone.

The Dissymmetry of the Body and Its Striking Results

WERE you ever lost in a London fog or a driving snowstorm or even in a tract of dense woods? If so, you probably experienced the usual annoying result of finding yourself walking in a circle in spite of all your efforts to follow a straight line. Physiologists have studied this curious phenomenon and come to the conclusion that it is due to the fact of the difference which always exists between the two lateral halves of the body, and which causes one of them to show a constant though unconscious tendency to exert a pressure upon the other. Some recent experiments in Vienna have thrown further light upon this difference between the two sides of the body and its effects. It was found that in spite of all orders to the contrary persons walking on foot showed a constant tendency to turn to the right, so that a definite effort of the will was required in order to turn to the left. The famous German physiologist, Professor Abderhalden, became interested in this question and investigated it further in the Physiological Institute at Halle. In this building there are two similar stairways one running to the left and the other to the right, and both placed at right angles to a short flight of steps at the entrance. Observations showed that by far the greater number of students in the building regularly took the right-hand staircase when they come to choose. Inquiry proved, however, that left-handed students, with few exceptions, made use of the left staircase.

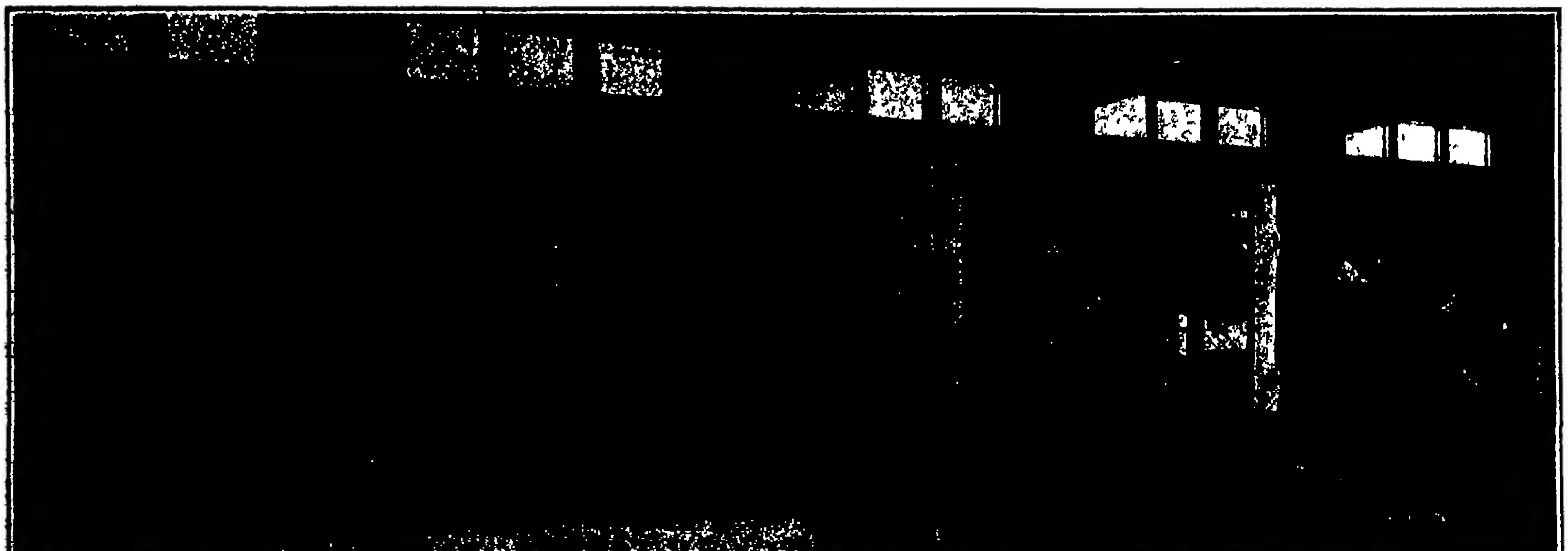
The same results were observed in the case of the general public as well as in that of the students. When the stairs were descended, however, there was practically an equal use of the two sets of steps. This is doubtless due to the fact that much more effort is required to ascend a stairway than to descend it.

Prolonging the Life of Insects by Variable Temperatures

SOME very curious experiments have recently been conducted by M. Louis Déstouches, with respect to the possibility of prolonging life in butterflies and caterpillars. The insects used were specimens of the *Galleria mellonella*. The entire evolution of caterpillars of this species ordinarily required a period of about two weeks at the optimum temperature of 37 deg. Cent. According to the *Bibliothèque Universelle*, Lausanne, for June, 1921, a lowering of the temperature retards the development, 15 days being required at a temperature of 34 deg. Cent. and 25 days at 27 deg. Cent. At a temperature below 17 deg. Cent. the caterpillar rarely undergoes a transformation into a butterfly, on the other hand, it continues to live for two or three months though it appears more or less enfeebled. Between 10 deg. Cent. and 4 deg. Cent. it ceases to eat and even to move and perishes at the end of the month. Strange to say, however, at a temperature still lower, namely, from 1 deg. Cent. to 2 deg. Cent. the vital processes are so much retarded that it lives for six months, undergoing a loss in weight during this time of only a few milligrams—but if the temperature be then raised to the optimum, it takes up the interrupted course of its development.

The experimenter subjected the caterpillars to two alternating temperatures, 1 deg. Cent. and 37 deg. Cent., each exposure lasting for 24 hours at a time. Under these conditions 25 days were required for development. But it was observed that this prolonged period of development exerted no influence either upon the length of life or the activity of the resultant butterfly. In other words the vital activities of the caterpillar may be retarded by cold without affecting the vitality of the butterfly, a point of great interest to entomologists, agriculturists and horticulturists, as well as to the general scientist.

Furthermore, it was observed that when butterflies are subjected to alternating temperatures the length of their active life is vastly prolonged and they also become more prolific. Under such conditions instead of dying at the end of six or eight days they live for more than a month (30 to 35 days), while instead of laying 10 or 15 eggs they lay from 25 to 35. This is really startling since it implies that under certain conditions of variable weather, which is a common enough occurrence in many climates, an alternation of temperature between 37 deg. Cent. and 1 deg. Cent. will cause butterflies to live five times as long as usual and to produce at least twice as many as they commonly do of their voracious offspring.



The wonder of it is that the number of airplane accidents is so small. Machines such as the one here shown—old, discarded war-time airplanes—have been bought and reassembled by inexperienced hands and then used in actual flying

Grouping Our Power Plants

The Superpower Survey's Impressive Figures, Which Afford Plenty of Food for Thought

By Robert G Skerrett

THE recently completed Superpower Survey reveals one phase of our national wastefulness, and, incidentally, shows how much more we shall have to pay for motive energy in the course of the next few years unless we mend our ways. Conversely, this impressively illuminating investigation brings to light that it is possible for us greatly to amplify our power resources and yet effect an annual saving of more than half a billion dollars!

But the story of potential economies is a longer one. The experts have disclosed that we can so coordinate existing steam electric and hydroelectric plants that, in combination with others to be built, it would be practicable to obviate the mining and the transportation of 50,000,000 tons of coal yearly! Or, if the demand develops, this measure of fuel can be supplied to sections of the country lying outside of the proposed Superpower Zone, benefiting those regions proportionately without augmenting the output of the mines.

At first blush this whole impressive proposition sounds like a promise of much for nothing. Such is not the case, however for the establishment of the Superpower zone will entail the expenditure of many hundreds of millions of dollars, in return for which the people will profit to the extent mentioned. This is the assured outcome of engineering efficiency applied on a gigantic scale and once more we have brought home to us the wonders that can be wrought through the agency of electricity.

The area embraced within the Superpower Zone has been somewhat enlarged since the project was first conceived by William S Murray nearly two years ago and now may be described as that territory lying between the 39th and the 44th parallels of latitude and extending inland from the Atlantic seaboard an average distance of 150 miles. Inside of the arbitrary boundary thus established live fully 25,000,000 of the nation's population and the workers of this bustling section of the Union turn out in value quite 40 per cent of America's manufactured commodities. The purpose of the Superpower System is to make it feasible for this intensified industrial sphere to carry on its vitally important manifold activities with greater ease and to meet unchecked the still heavier tasks of the future. In short, to achieve these ends at a lower unit cost through the medium of a plenty of cheaper electromotive force.

One need not be more than casually familiar with the trend of industry abroad to realize that substantially all of our competitors in the markets of the world are bent upon developing their water power resources and equally intent upon creating highly efficient steam electric plants so that electricity can be utilized more widely by their railways and in their shops and factories. The object, of course is to reduce the consumption of fuel or to get a greater volume of power for every ton of coal burned. The ultimate aim is to lessen manual labor, to increase production through greater dependence upon machinery and to neutralize the charge for present-day wages. This movement is a menace to America's commercial position, and must be offset by the organization of facilities which shall make us strong enough to hold our own in foreign trade.

The Superpower System has not been planned with an eye single to putting us in shape to sell our wares on favorable terms in alien lands. It is designed to make our domestic life a fuller and a pleasanter one through the innumerable conveniences and comforts that go hand in hand with amplified applications of electricity. It is counted upon to bring town and country into closer touch, to put the rural dweller in some respects on a parity with his city brother, and to enable the trunk lines concerned to move their passengers more expeditiously and to transport greater volumes of profitable freight. It is a matter of common knowledge how heavy a burden the coal consumed by any steam railway lays upon it and what this imposes in the way of a reduction in revenue-making tonnage.

Today, within the proposed Superpower Zone there are operated 315 electric public utilities, the majority of them running independently of one another, a total of 18 railroads, and no fewer than 70,000 industrial establishments that use varying amounts of mechanical energy. This great manufacturing section is not favored like the West Coast States with an abundance of falling waters from which to draw motive force. By 1930 the demands for electric current in the Superpower Zone will total 31,000,000,000 kilowatt hours, and our existing and prospective hydroelectric stations would not be able to supply more than 21 per cent of this. Two years ago 15 per cent of the total output of the electric utilities was derived from water power. Therefore, it is inevitable that we look to steam electric plants to furnish the other necessary 79 per cent. This point is purposely emphasized because there is a popular and erroneous belief that hydroelectric developments in the Eastern States would go much further toward satisfying requirements.

Plainly, coal is sure to be the principal power reliance in the area under consideration, and it should be a matter of national congratulation that there are vast deposits of some of the best coal in the country within convenient reach of this gigantic beehive of productive effort. Even so, the primary purpose is to utilize this fuel economically and thus to conserve it for future generations of our people. This end will be attained through engineering skill that will coordinate the hydroelectric and the steam-electric facilities in a way to provide a maximum of energy for a minimum of plant investment and operating expense.

As indicated on the accompanying map of the Superpower Zone, the system will include the erection of master steam-electric stations at tidewater inland on rivers etc, and at points within the anthracite coal region wherever an ample supply of condensing water can be counted upon and these sources of energy will be augmented by hydroelectric power stations in the zone as well as others located outside of it but not too far away to transmit current economically. According to the experts, current at a potential of 220,000 volts can be dispatched over the wires a distance of 350 miles with a loss of not more than 6 per cent. This shows how long gaps can be spanned effectively and generating stations and users brought in a sense close together although actually remote.

Manifestly the proposed new steam-electric super power stations are to be set up where it will be practicable to secure the full benefits of low freight rates, and to take advantage of railway routes permitting short runs and easy delivery of coal. To be more specific, it is recommended that one of these steam electric plants be constructed near Pittston, Pa, to furnish a part of its energy to the contiguous anthracite region and the rest of its output to the Metropolitan zone—especially the New Jersey section of the latter. Another giant steam electric central station is contemplated close to Sunbury Pa, which will also feed power to the anthracite region, send a portion of its current to the load center at Reading, and transmit the balance of its electromotive force to Philadelphia.

Near tidewater a master steam-electric powerhouse is urged in the neighborhood of Boston to meet the electrical needs of that load center and also the industrial demands of Lowell and Newburyport, and for the load centers of New Haven, Bridgeport, Waterbury, and Hartford there should be provided another big steam electric plant to take care of that part of the country. All of the foregoing promise to give the quickest returns from the very beginning of the Superpower System, and it is furthermore planned to call into being, in the order named, the following prime hydroelectric installations. Plants on the Delaware and the Susquehanna Rivers for the purpose of supplementing the steam-electric stations at Pittston and Sunbury, the progressive development of the Hudson River projects to meet the growth of energy requirements in the load centers at Schenectady, Utica, Poughkeepsie, and Pittsfield and to take the first step in the Potomac River developments as soon as the demands of the Baltimore and the Washington load centers exceed the capacity of existing facilities.

It should be evident that the proponents of the Superpower Zone offer a scheme susceptible of gradual evolution, and in laying it out they have looked ahead and taken into consideration the territory's probable power needs nine years hence. We are told that had a Superpower System been available in the region under discussion two years ago there would then have been twenty economic load centers to which its energy would have been furnished. On the other hand, by 1930, if the scheme be carried out as proposed, there will be no fewer than thirty-five of these load centers.

In order to prevent confusion, let it be remarked that the Superpower project logically divides itself into three broad divisions, dealing, respectively, with the electric public utilities, the heavy traction railroads, and the manufacturing industries. It would be well to touch upon each of these in turn. For the past decade the load growth of the electric public utilities has increased at the rate of 11 per cent per annum. Today the yearly demand amounts to 12,821,000,000 kilowatt-hours, and if we assume an increment every twelvemonth for the next nine years of only 9 per cent the electric utilities will be called upon to supply 26,000,000,000 kilowatt-hours in 1930. This can be done efficiently and economically in but one way—by coordinating the existing plants so that they may cooperate throughout the length and breadth of the Superpower Zone with the superpower stations in generating and distributing electrical energy wherever it may be wanted.

For instance, the peak loads for the Anthracite and Mohawk-Hudson Divisions occur in the morning. The peak loads for the other divisions come along in the afternoon, and the annual peak load for the entire Superpower Zone reaches its climax about five o'clock in the afternoon—the heaviest concerted burden being laid upon the power plants usually in December. Clearly, then, this shifting demand can be met successfully with a minimum of equipment only through a give-and-take service among the associated powerhouses.

The base load steam-electric stations conceived by the experts of the Superpower Survey will range from 60,000 kilowatts to 300,000 kilowatts, and the proposal is to install no turbo-generator units of less than 30,000 kilowatt capacity in any of these master plants. The reason for this is that experience has proved conclusively that large units can produce power more cheaply than small ones. For example, the cost of fuel at stations of more than 100,000 kilowatt capacity, for a given volume of energy, is only one-third of that of one of less than 1000 kilowatts, while the maintenance charges of the big establishment average but one-fourth of those of the small powerhouse.

Out of 558 electric public utility plants now within the projected Superpower Zone there are but 86 which are equal or greater in capacity than the average-sized station contemplated for the Superpower System up to 1930. Further out of the 1074 generating units operating inside the boundaries of the zone two years ago—counting only those of 500 kilowatts and upward, there were only about 20 that had a capacity in excess of 30,000 kilowatts. This is a fair indication of the need of betterment in order to bring down the cost of current.

Analyzing the performances in 1919 of 400 steam electric power stations, the investigators found that the average of the electric utilities within the zone burned 2.78 pounds of coal per kilowatt hour and called for a heat utilization of 35,800 B.t.u per kilowatt-hour. In contrast to this, based upon the best up-to-date engineering practices, it is promised that the steam-electric superpower plants will have a fuel rate of not more than 1.41 pounds per kilowatt hour and that their boilers will do this on a heat utilization of 18,300 B.t.u per kilowatt-hour—the big base load steam-electric stations running the while at the same annual capacity factor.

Again, the Superpower Survey has brought to light that the disassociated working of the numerous electric public utility plants necessitated, in 1919, a generating capacity 46 per cent greater than the annual peak load, and it seems that the resulting capacity factor did not exceed 20 per cent. Fancy the overhead represented by so much unprofitable machinery. Conversely, we are assured that by 1930 the Superpower System, being able to take advantage of joint reserve apparatus, will get along with a generating capacity but 9 per cent in excess of the annual peak, and that at the same time the coordinated stations will be in a position to raise the yearly revenue-making output to 45 per cent. This will represent a gain of 78 per cent, and the benefits should logically be reflected in the consumers' bills. The annual saving will then reach $239,000,000, and the allied steam-electric public utility plants will do their work with 19,140,000 fewer tons of coal than stations of like aggregate capacity operating independently, as at present.

Density of traffic, as has been explained frequently in the last few years, determines whether or not it is worth while for a steam railroad to adopt electric traction. Within the Superpower Zone there are 36,000 miles of main line, yards, and sidings, and the Survey has disclosed that 19,000 miles of the trackage could

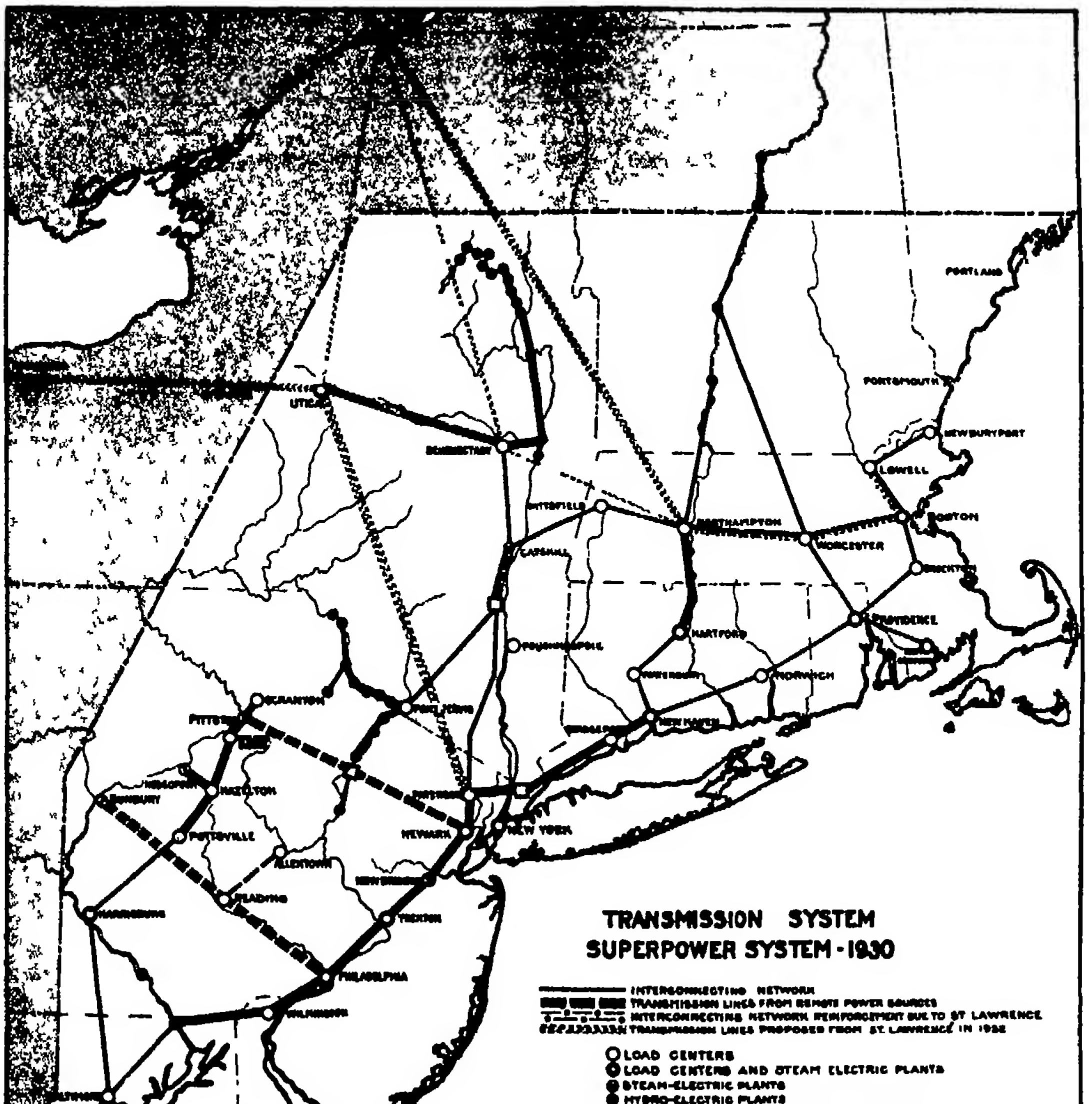
with profit be electrified. This would entail a capital expenditure of $570,000,000, effect a yearly reduction in operating costs of $82,000,000, and yield a revenue of 14.3 per cent on the investment after deducting overhead charges and a liberal rate of interest on the money borrowed to bring about the transformation. It seems unnecessary here to repeat the well grounded advantages claimed for the substitution of electric haulage.

Mr. William S. Murray, who has been in charge of the Superpower Survey, makes this point in favor of supplanting the steam locomotive on the lines under discussion: "The normal demand for money for extensions and betterments of the railroads within this zone is approximately $150,000,000 annually, an amount which, even in the face of present construction prices, would suffice in three or four years to cover the cost of the entire electrifications mentioned. Should we continue to tinker with an old and defective machine when it is impossible to escape the installation of the modern and efficient one?"

And now for consideration of what the Superpower System will mean to industry within the confines of the zone. Among the 76,000 establishments using power, and which were the subject of study by the technicists of the Survey, there are manufacturing plants, mines, quarries, government shops, and laundries. In short, widely diversified forms of productive activity. The analysis of the data gathered reveals that in 1919 the equivalent of 9,311,440,000 kilowatt hours was developed by prime movers individual to the industries concerned. The energy purchased amounted to 3,338,800,000 kilowatt hours. Further, it seems that 4,008,200 horsepower of prime movers might have been shut down to advantage and added energy bought instead to the amount of 5,623,800,000 kilowatt-hours, which would have made a total of 8,962,000,000 kilowatt hours for 1919. Had power been thus secured in this measure, the saving in coal would have aggregated 13,502,100 tons, or 71 per cent of the coal which was used for the production of energy. The Survey has established the fact that it would be in the direction of economy if all industrial establishments requiring 500 horsepower or less went into the market for their energy. It is only when the service demands rise above 500 horsepower and involve at the same time some special applications for heat that an isolated plant is justified. Even then, it seems that there should be central-station connections in order to provide against irregularities of load.

Any considerable improvement in the efficiency of power production by isolated plants is limited because of the necessarily small average amount of machine capacity involved. While we are assured that the power needs for industry within the zone have been studied on a conservative basis, yet it appears that it will be possible in 1930 for our shops, factories, etc., to effect a twelvemonth saving of $190,000,000. This can be achieved despite the fixed charges against an investment of $188,000,000 for the motor equipment that must be installed in them to receive energy from the Superpower System.

Taking it by and far, little if any comprehensive knowledge has heretofore existed among power users and electric public utilities regarding the growing demand for energy in the different sections embraced by the proposed Superpower Zone, and there has been a corresponding lack of grasp of what these changes would portend economically if met by properly coordinated, interrelated power plants. The Survey has given this matter careful consideration, and has planned accordingly for the location of its big central stations. The load factor for the entire zone has risen from 34 per cent in 1910 to 39 per cent in 1919. Some geographic divisions, such as the Metropolitan, show but very little increase in load factor, while in others, the Southern Division for instance, the expansion has been from 33 per cent to 48 per cent—the augmented loads being largely due to additional industrial demands in those districts.



Map of the Superpower System Zone, showing the location of the load centers and power plants, together with the arrangement of the transmission network

In four years, i.e., by 1925, 50 per cent of the total generating capacity for superpower operation will be centered in plants owned by the present electric utilities, and they will produce about 26 per cent of the energy. By 1930 the generating figure will drop to 30 per cent and the plants will furnish only 18 per cent of the total output—in other words, their principal use will be to take care of peak loads. The heavy base loads will be carried by the master stations, to be built as distinctive features of the Superpower System.

The Survey has shown that in 1919 the electric public utility plants within the zone both water power and steam driven, had equipment averaging 7900 kilowatts per plant. Per kilowatt of capacity the master will have increased to 29,900 kilowatts. But even more striking is the potential development in the steam electric establishments, which will jump in the same period from a mean of 10,000 kilowatts to 218,000 kilowatts per plant. Per kilowatt of capacity the master powerhouses will cost much less to erect and to equip.

To bring this whole subject to a focus let us see what will be the difference in outlay for the Superpower System and the price that would have to be paid for a commensurate amount of energy developed agreeably to present-day practice among the independent electric public utilities. The new money required for the Superpower System by 1930 is put at $993,218,000. This is an immense sum, but it is less by $163,000,000 than the amount that would have to be spent for the proper development of the prevailing disassociated electric utilities.

So far the steam power plants and the hydroelectric ones have been considered separately. Much can be gained, however by bringing the two sources of energy together. The Superpower Survey report discloses that an economic combination of steam and water power installations can be made which with an increased investment of $44,838,000 will yield a return annually of $69,530,000. Here we see exemplified one of the prime advantages of superpower production expense being reduced by reason of an interconnecting system which permits of the highest efficiency in the steam stations and of the best or maximum use of the available water power.

The report accepts as a certainty the establishment of hydroelectric plants on the St. Lawrence River and further developments at Niagara Falls, both of which will eventually deliver power to the wires of the Superpower System even though they lie outside of the prescribed zone. These however, are not likely to be in a position to lend aid to the Superpower System much before 1932. It is estimated that the average cost for St. Lawrence power will then be $0.0046 per kilowatt hour for 600,000 kilowatts, at 80 per cent load factor, delivered at Utica, Schenectady, and Northampton. The total annual outlay for all St. Lawrence power in 1932, transmitted to the load centers of eastern New England, western New England, the Mohawk and the Hudson Divisions will be $130,273,000. If, on the other hand, the excess energy requirement of 1932 over that of 1930 were furnished by new steam-electric plants in the Superpower Zone the charge would aggregate substantially 141,601,000. The St. Lawrence development, therefore promises to net a yearly saving of $11,328,000 to the sections drawing from it. Finally, the total investment required for purchased St. Lawrence power would be $24,820,000 less than that involved in erecting new steam-electric plants to supply this energy.

The existing transmission systems of the electric utility companies, now consisting of about 1200 miles operating at 33,000 volts or higher will be distribution rather than transmission circuits when they are eventually linked with the conductors of the Superpower network. In 1930 the Superpower System should be composed of 970 circuit miles of 220,000-volt lines and 4090 circuit miles of 110,000-volt interconnecting wires. When the transmission systems for the St. Lawrence and the Niagara developments are constructed they will add 3140 circuit miles of 220,000-volt lines to the Superpower Zone System.

The New Marine Salvage System

Lifting a Sunken Ship by an Equalized Pull Upon Her Main Frames

WHEN reports came from England that the British had taken up the problem of raising the ships sunk by submarines during the war and that they had been successful in recovering many of them, the hopes of the public were raised to expect almost the impossible. New systems and schemes were being proposed at most every day. Many of them were tried and some of them were found to have merit, but although several hundred ships were salvaged the work has been practically abandoned because it has been found impossible to raise a ship of any considerable size from other than comparatively shallow water.

Most of the valuable ships which had on board extensive cargoes were sunk far enough off shore and in such depth of water, that all methods were found to be inadequate to overcome the difficulties encountered. During stormy weather it was impossible to use surface equipment in the shape of horizontal pontoons, and although many of the ships were raised by lashing other vessels on each side of them to sustain the dead weight of the sunken hull and cargo till the operation of pumping the water from the submerged vessel had been accomplished, a depth of more than about six feet of water over the deck of the sunken ship rendered this operation impracticable since the structure of the ship was unable to sustain the pressure. Nearly all previous methods have involved either the attaching of cables to the hull of the vessel in such number that the weight of the ship could be overcome by means of some lifting power exerted from the surface, or by means of compressed air forced into such compartments of the vessel as could be made air tight or by a combination of these two methods.

The work of controlling the surface-lifting devices has always been attended by great danger and uncertainty, owing to the difficulty because of wave motion, tides and current, of maintaining the proper relation between the sunken ship and the equipment. Sudden storms have delayed operations for long periods of time and have often swept away in a few hours the work of months, besides destroying equipment worth many thousands of dollars.

The accompanying drawings show the plans that have been developed by Mr. Jesse W. Reno, of New York, covering apparatus which he claims will overcome all of the difficulties experienced in past salvage operations, and at the same time make it possible to raise ships from greater depths than has ever before been possible. Mr. Reno is a well known consulting engineer, the inventor of the moving stairway or escalator. His plans, while novel, contain no untried elements. Every essential feature of the equipment has been tried and proved in other lines of work. The application of these principles and equipment is, however, new in its collective application to the raising of ships.

The Reno system consists in the use of a series of multiple-unit, open bottom vertical pontoons, submerged to the depth at which the sunken vessel lies, and there securely fastened to the hull and filled with air. The work of preparing the hull for the attachment of the pontoons is performed by two operators working within a mobile diving chamber or tractor, which is lowered from the surface to the sea bed where, under its own power, it maneuvers around the ship. The men in the chamber work under ordinary surface conditions, the air being purified and renewed by the same system as is used in submarine boats.

When the sunken vessel has been located the working chamber is lowered to the sea bed by means of a cable. Through the center of this cable runs an electric cable which supplies power to an electric motor within the chamber. Telephone communication is also maintained through this core with the mother ship, so that at all times there is perfect coordination between the men at the bottom and those at the surface. The electric motor drives a pair of twin drills, which when the chamber has been moved to the side of the vessel, drill holes through the plates of the hull, one on each side of, and close to, the frames of the ship, thus affording the strongest possible point at which to attach the pontoons. It should be noted that contrary to popular impression the sea bottom adjacent to the coasts, is not covered with deep mud, but except at the mouth of rivers and some estuaries consists of firm, clean bottom suitable to the operation of such a tractor as is here used.

Two sizes of pontoons are used, one twelve feet in diameter and sixty feet long of 200 tons' lifting capacity and the other twelve feet in diameter and thirty feet long of 100 tons' lifting capacity. The holes are drilled in sets of four or eight depending on the size of pontoon to be used. The pontoons are built of steel, electrically welded. At a point slightly below the center of buoyancy, within the pontoon, there is welded a circular truss construction, which distributes the strain of the lift to all parts of the pontoon. The attaching cables are mounted on an equalizing lever, so arranged that an equal strain is maintained at all times on each cable in spite of the uneven drilling of the holes, or should there be any movement of the pontoons due to wave motion, after the ship has been brought to the surface. At the lower ends of the cables are standard crane hooks, also mounted in pairs on equalizing levers.

Outside the working chamber, at the rear of the tractor is a long winding drum, controlling two cables spaced about eight feet apart. Attached to these cables is a hollow steel float of sufficient buoyancy to rise to the surface when released, carrying the cables with it. After the necessary number of holes have been drilled in the hull of the vessel the float is released by the operators within the chamber and the float rises to the surface. The float is fitted at the top with a hook and near the bottom of the pontoon is a staple, its position being marked by a line of paint running to the top of the pontoon. Upon the arrival of the float at the surface a diver secures himself to the float and the operators in the working chamber are signaled to pull the float down. When the diver reaches the position of the staple he inserts the hook and rises to the surface. The workers in the chamber are notified and starting the drum in motion they pull the pontoon down to its position of attachment. Sufficient air is maintained in the pontoon during this operation to keep it upright. This is done by means of an electric gage which registers the pull of the winding drum in the chamber and in the operating room of the mother ship.

Salvage tender with vertical lifting pontoons

The insertion of the hooks in the holes is performed by means of an adjusting rod operated by the men in the chamber. After the insertion of the hooks sufficient air is pumped into the pontoon to insure a firm lift and to maintain it in position while the other pontoons are attached by the same method.

The pontoons are towed out to the position of the ship in a horizontal position. Prior to their launching a diaphragm is placed over the open end, the contained air causing them to float high in the water. On arrival at the mother ship this diaphragm is removed and through a valve in the upper end the air is allowed to escape till the pontoon floats in a vertical position and is barely awash.

The pontoons are filled with air by means of a sea-bed siphon, which delivers compressed air from the mother ship to each pontoon in turn. Care is taken in filling the pontoons to maintain an equal distribution of strain and to insure the proper balance of the ship when she rises.

In shallow water, or where the sea is so irregular that the use of the tractor might not be advantageous divers are used to drill the holes using a form of sea-bottom sled on which is mounted the necessary apparatus for performing the operations.

Mr. Reno claims many advantages for his system. Tests made in submarine boat work show that at a depth of more than fifty feet below the surface there is practically no movement of the water due to wave motion, thus enabling all the operations to be carried on in still water. Any slight movement of the water would not affect the operation of attaching the hooks, since the pontoons are hauled down, not lowered, and are under the control of the sea-bottom operators. Should a sudden storm come up the attached pontoons can be left attached to the hull and the working party seek shelter in port. After the subsidence of the storm work can be continued from the point where it had been stopped without any damage having been done.

There is therefore no danger to the workers or to the equipment. The equipment being in units can be used repeatedly, the only question to be decided being the number of units necessary to raise the weight of ship. The use of a great number of pontoons also distributes the strain to many different parts of the ship, so that at no one point is there sufficient strain to cause any damage to the plates or structure of the hull.

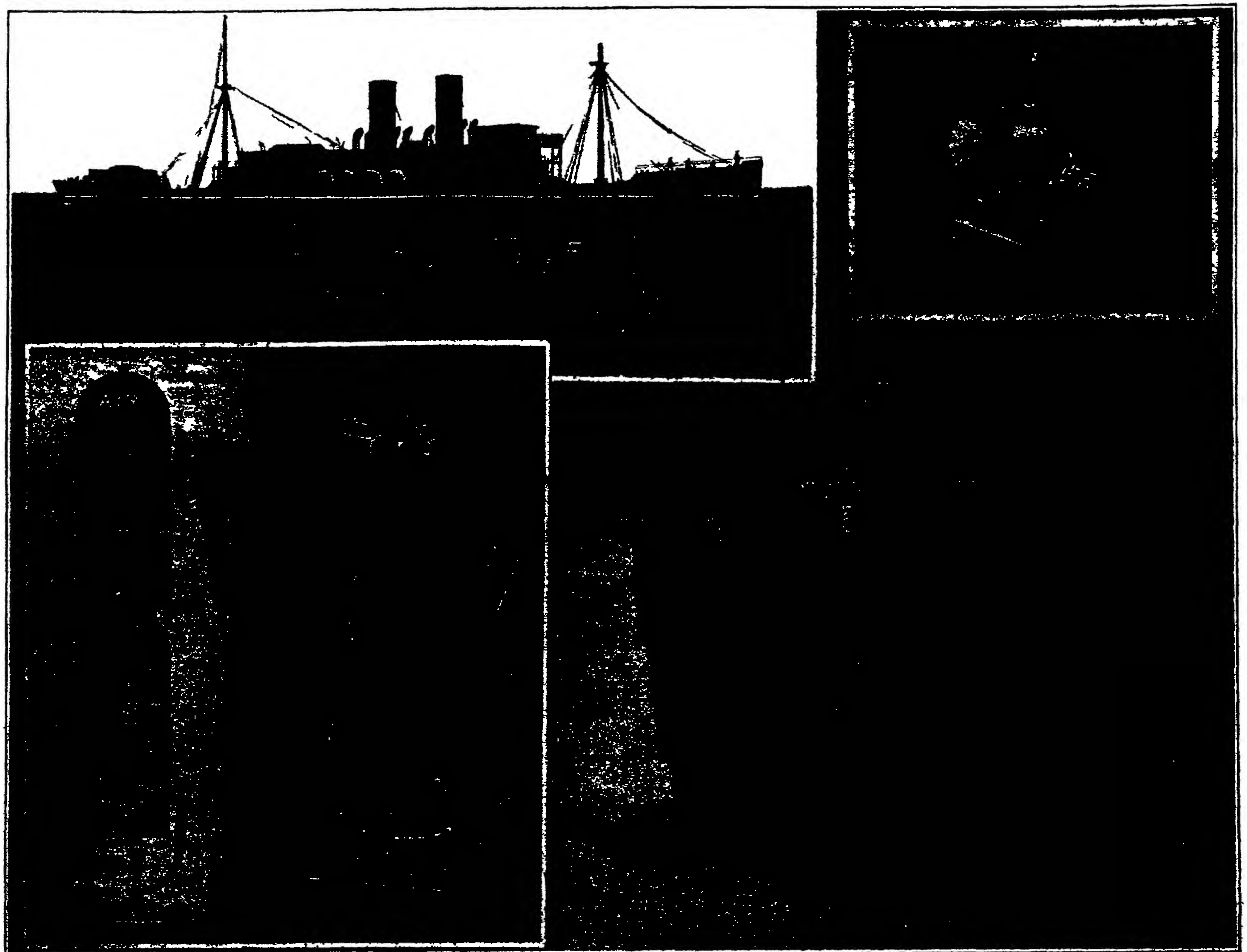
Should a ship to be raised be found to be lying on her side, a position which is very rare, the pontoons are first attached below the edge of the deck and enough air pumped in to pull her upright when the usual method will be followed.

After the ship has been raised to the surface, she is towed to a protected position where she can be elevated to a sufficient distance to be towed into port and placed in dry dock. This consists in placing under the ship a series of box-shaped pontoons. The side pontoons are then deflated and drawn down one at a time and hooked along the lower edge of the bottom pontoons, the holes drilled in the ship being then plugged and the side pontoons reinflated. The added buoyancy will raise the ship's deck well above the surface.

Working under the Reno system the size of the ship to be raised does not militate against the success of the apparatus, as with the vertical pontoon the length of the ship always affords sufficient space along which to assemble enough pontoons to exert the necessary lifting power. In the opinion of prominent engineers who have carefully examined Mr. Reno's plans there is no reason why the equipment should not perform every function claimed for it. In fact the opinion has often been expressed that it is perfectly feasible to raise the "Lusitania," the "Britannic" and other large vessels with the Reno system.

Rain and Radio-Activity

THE interesting question has been raised by a French investigator, M. P. Loisel, as to whether there is any connection between rain and the radioactivity observed in springs. He observed that the radioactivity of the warm baths at Orpe is variable. The water of the spring called the *Source des Fées*, which is a cold spring having a temperature of 10 degrees Centigrade, contains radium emanation. This emanation is at its maximum after a rainfall, reaching its highest point from the fifth to the eighth day and the greater the rainfall the greater this maximum.



Left upper: Vessel, after being raised from deep water by vertical pontoons, is given a final lift by horizontal pontoons until her deck is clear of the surface. *Right upper:* Tractor working chamber. *Left lower:* Sectional views of vertical pontoons, showing lifting hooks being guided into holes drilled in vessel, by a T-rod, operated from working chamber; also note sea-bottom syphon through which air is being fed for displacing water in pontoon. *Right lower:* Salvage ship, with pontoons attached.

A new marine salvage system, which makes use of a tractor working chamber and numerous pontoons

A series of double-cup fractures obtained in physical tests of the new rolled nickel

Rolling Pure Nickel

A Recent Metallurgical Development That Puts This Metal on a New Basis

By A R Surface

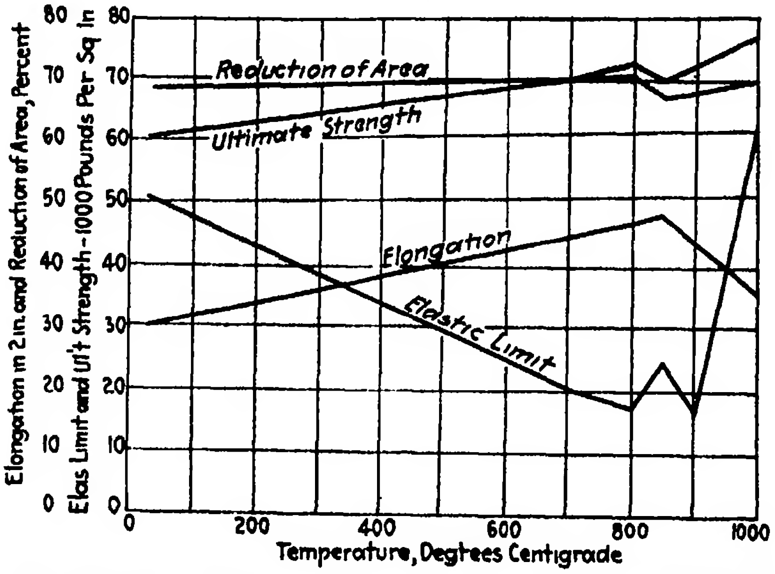
WHILE nickel is a malleable metal its rolling like steel into various forms and its forging have always been regarded as impossible except under difficulties including frequent annealing and other treatments. The rolling of 99-per-cent pure nickel into the various shapes into which mild steel is rolled is now commercially possible and is an achievement of exceeding interest to the metal working trade Forgings of this metal are also announced, as well as its fabrication similarly to mild steel An interesting feature of this new development is that the same apparatus is used for working the nickel as is used for the steel It is possible to roll steel bars and then immediately to introduce pure nickel billets or ingots into the rolls.

Dr Charles T Hennig, who is responsible for this development in nickel products, has experimented for many years in making nickel malleable enough to be rolled or forged into various shapes He considers that the objects he has sought are now fully attained, though the rolling of pure nickel had long been considered impossible The company's plant is located at Hyde, a small town in Clearfield County, Pa It had previously been operated as a rolling mill In 1916 Dr Hennig obtained possession of it. After completely rehabilitating it and installing new equipment, he continued the rolling of steel while the development of the commercial production of pure nickel was under way

Because of the non-corrodibility of pure nickel and its antiseptic properties, those interested predict its extensive use in many industries. It is especially suitable, as insuring easy sterilizing, in dairy machinery of all kinds In dye house equipment, where acid and alkaline solutions are used In gas and oil engines, where extremely high temperatures prevail, in marine installations, where parts come in contact with salt water In pickling and chemical works, in power plants and mining equipment A large use for it as milk cans is expected The high scrap value of the metal is an important commercial factor Unusual strength and durability, affording lighter weights for specified purposes, and the fact that non-corrodibility insures longer usefulness, are cited as offsetting the higher cost.

The new product has great resistance to corrosion caused by acid fumes and acids, by alkalies, superheated steam, etc It oxidizes little at high temperatures. It can be welded to iron, to steel, or to itself It is white in color It has a specific gravity of 8.871 at zero Cent The average chemical composition shows carbon 0.025 per cent, phosphorus 0.015 per cent, sulfur, 0.025 per cent, silicon, 0.155 per cent, copper, 0.12 per cent, iron, 0.6 per cent manganese, a trace, and nickel (plus cobalt), 99.06 per cent The melting point is 1485 deg Cent

For the crude nickel obtained in the open market as raw material Dr Hennig had developed a special treatment preliminary to rolling it into the many shapes produced at the Hyde plant Striking malleability, under all conditions of heat and cold, has been secured The writer has seen a 4 inch section of a 1-inch round rolled bar of this metal flattened cold by up-setting under a 2500-pound hammer until it was about 3½ inches in diameter and ⅝-inch thick with no cracks or seams apparent. Also a 1 inch bar has been forged down hot to about ½ inch and then flattened under the hammer until cold This was then reheated and folded over on itself and again flattened under the hammer, until there were 128 folds in the resultant piece, which showed only a few evidences of cracks or brittleness. It is Dr Hennig's claim that this is not possible with ordinary commercial pure nickel



The physical properties of 99 per cent rolled nickel, at the temperatures to which it is likely to be exposed

The raw material is refined and specially treated in small 2 to 3-ton open hearth furnaces, specially designed by Dr Hennig The hot metal is poured into ingot molds such as are used in making steel, at a temperature of approximately 3200 degrees Fahrenheit. Various sizes of ingots are cast the largest at present being one ton These ingots are later broken down under hammers or in rolls after the usual preheating To insure a perfect surface on the product, the ingots and sheet bars are always carefully machined Sheets are rolled down in packs of 8 to 32 sheets to a thinness of 0.001 inch A large powder company is using this very thin metal in a cartridge for smokeless powder

The Brinnell value of the hot rolled material is given as 108 and of the cold rolled up to 195. The metal can be bent back on itself without fracture, and it is stated that heat has no effect on the ultimate strength When heated in air by a blow pipe at a temperature of 1900 degrees Fahrenheit for 3½ hours no scale is formed, and the surface is only slightly tarnished by the heat. It can be heated almost to the melting point without the formation of scale Among its physical properties the high elastic ratio is noteworthy

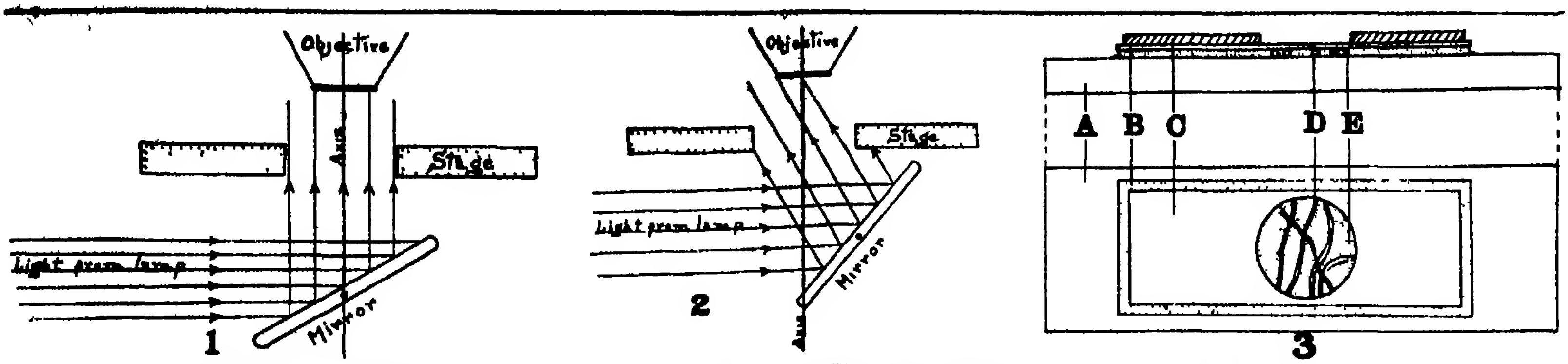
Besides the straight rolled nickel, the company produces nickel-coated steel sheets or other products by rolling nickel sheets in conjunction with steel billets By placing the nickel on one or both sides of the steel billet or slab the desired product is obtained by welding It is possible to produce a highly polished nickel-coated steel sheet Tubes have been produced for service in locomotive boilers, and one railroad has obtained interesting results in such service

It has been found practically impossible to break sheets of moderate thickness by bending A sheet 15 feet x 52 inches x 3/16 inch thick is exhibited as the largest that has been made from pure nickel In the passage through the rolls no scale is given off, and the working of the metal hot is a pleasant sight. The nickel can be quickly annealed by heating to a yellow heat and plunging into cold water It will then become as soft as copper If plunged into liquid air it still retains its malleability while copper and some other metals become so brittle that they will disintegrate or become granular

The open-hearth furnace of special design in which the crude nickel is treated preparatory to rolling

Chemically Pure Nitrogen from the Air

THERE are various processes for obtaining nitrogen from the air, such as passing air over incandescent copper, liquefying air, etc But these do not suffice to produce nitrogen of sufficient purity to be used in electric lights. A new patent is announced (in *Die Umschau* (Berlin) for Dec. 25, 1920), by means of which it is possible to produce nitrogen having a 99.5 per cent degree of purity directly from the air For this purpose the oxygen of the air is burned by means of a hydrogen flame and both gases are heated, before being mixed, to the temperature of combustion, in order to ensure complete combustion. This is accomplished by means of a porous partition which is heated to 800 or 900 deg. Cent. One of the two gases is conducted through the pores of this diaphragm by means of which it is heated to the desired temperature, while the other gas is made to reach the same temperature by being led past the furnace. As a general thing the heat liberated by the combustion of the hydrogen is sufficient to maintain the diaphragm at the required temperature, so that it has to be freshly heated only at the beginning of the reaction. The mixture of gases which escapes from the furnace consists almost entirely of nitrogen and water vapor After the condensation of the latter the gas is passed through a highly heated tube filled with copper oxide and metallic copper, in order to remove traces of oxygen or any excess of hydrogen. This process can also be employed for other purposes, such as the separation of argon from the air or from mixtures containing oxygen.



1. Diagram of the microscope stage, with the mirror set for vertical, or direct transmitted, light. 2. How the stage is set for oblique light. 3 The make-up of the fiber compressor: A slide B, cover glass C brass rectangle with circular aperture D fibers E mounting solution

Sketches showing the construction of the microscope stages and other apparatus employed by the author in the examination of textiles

Fabrics Under the Microscope

Some Methods in the Microscopical Examination of Textile Fibers

By Leon Augustus Hausman, Ph.D

DURING the past few years the microscopical examination of textile fabrics has been gaining in favor with investigators as a ready and sure means of identification of the stuffs used in weaving and spinning In a recent contribution to this paper (Hairs That Make Fabrics, Feb. 21, 1920) the writer described some microscopical methods and results in the examination of the commonest mammal hairs used in the textile industry In this paper it is his aim to recount some of the processes of treatment in the microscopic examination of the vegetable and artificial fibers, which he has found to be the most useful in identifying the materials used, detection of adulterants, and so forth.

The textile fibers of commerce may be divided into four great classes animal, vegetable, mineral and artificial fibers. The animal fibers, *i.e.*, hair and silk, are essentially nitrogenous in composition, that is to say, are composed of substances classed under the general name of proteids. Animal fibers often contain sulfur, and when burning give out a peculiar, pungent, characteristic empyreumatic odor, by means of which it is often possible to distinguish fabrics of animal from those of vegetable derivation. Alkalis attack animal fibers, causing them to dissolve, or tend to do so, but the action of mineral acids is withstood to a considerable degree

Plant fibers, on the other hand, lack nitrogenous compounds almost entirely, and are composed of woody material, called cellulose, starchy in nature, and burn readily, giving off little or no odor, and being reduced to a fine whitish ash. Unlike the animal fibers, also they are readily attacked by such acids as sulfuric and hydrochloric.

Mineral fibers are of rare occurrence in the textile industry, and are confined chiefly to the various kinds of the mineral of the same name Asbestos, in nature occurs as a mineral compound of silicate of magnesium and calcium, together with iron, and occasionally with a slight proportion of manganese Though it is found in a hard state, not unlike feldspar, it can be readily split up and separated into multitudes of whitish or greenish, slender, tough, flexible fibers. Some species of asbestos furnish straight fibers, others curly ones. It is the latter varieties that are chiefly used for spinning

The artificial fibers are of two sorts those which are of mineral, or inorganic origin, and those derived from vegetable products. The former group embraces such fibers as spun glass, *metallic threads of various kinds*, and slag "wool"; the latter comprises the various artificial silks. Spun glass fibers are prepared by various processes which draw out the molten glass into very fine threads which harden at once by reason of their rapid cooling. Glass fibers are sometimes used as the weft of silks, where they impart an unusual heaviness and glancing luster to the cloth Slag "wool" is prepared by blowing steam strongly through a mass of molten slag, producing a fluffy, wool like substance. This is little used in spinning, however, and cannot strictly be called a textile material Its chief use is for packing Various metals, such as gold silver, copper, etc, are drawn out into fine threads and used to a considerable extent in working into the designs in heavy brocades, trimmings, passementerie work embroideries, church vestments, tapestries, etc

The artificial fibers, strictly so-called, are the various artificial silks, composed of cellulose—the woody material of plants—and prepared in general, by dissolving this substance in some suitable medium, *e g*, ether and alcohol solution, and then forcing it through very fine openings. The thin streams of the solution quickly solidify, due to the rapid evaporation of the solvent medium, leaving behind the delicate threads of cellulose Because of the glossy, smooth surfaces of these fibers (see Figs. 6, 7, 9) they reflect the light readily and hence assume the lustrous appearance of the true silk fibers.

The microscopic investigation of textile fibers, of all derivations, has in the main been confined to examination under the microscope by what is known as transmitted light, *i.e.*, light reflected from the mirror beneath the stage of the microscope up through the specimen, and thence into the microscope tube Often the specimen under examination is bathed in oil or water, to render it more transparent, and more easily penetrated and illuminated by the light rays. In the examination of mammal hairs the writer has utilized several other methods of lighting and mounting, which have also yielded excellent results when applied to the study of other textile fibers. These, and the results which they afforded, are here described, in the hope that they may prove useful to microscopists engaged in textile examination

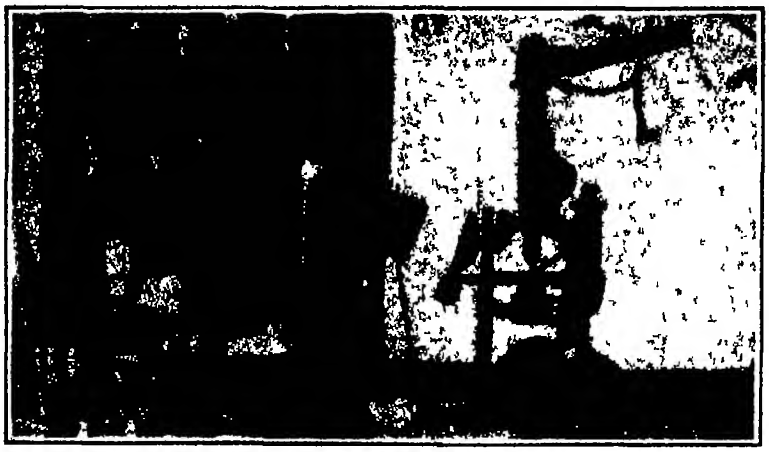


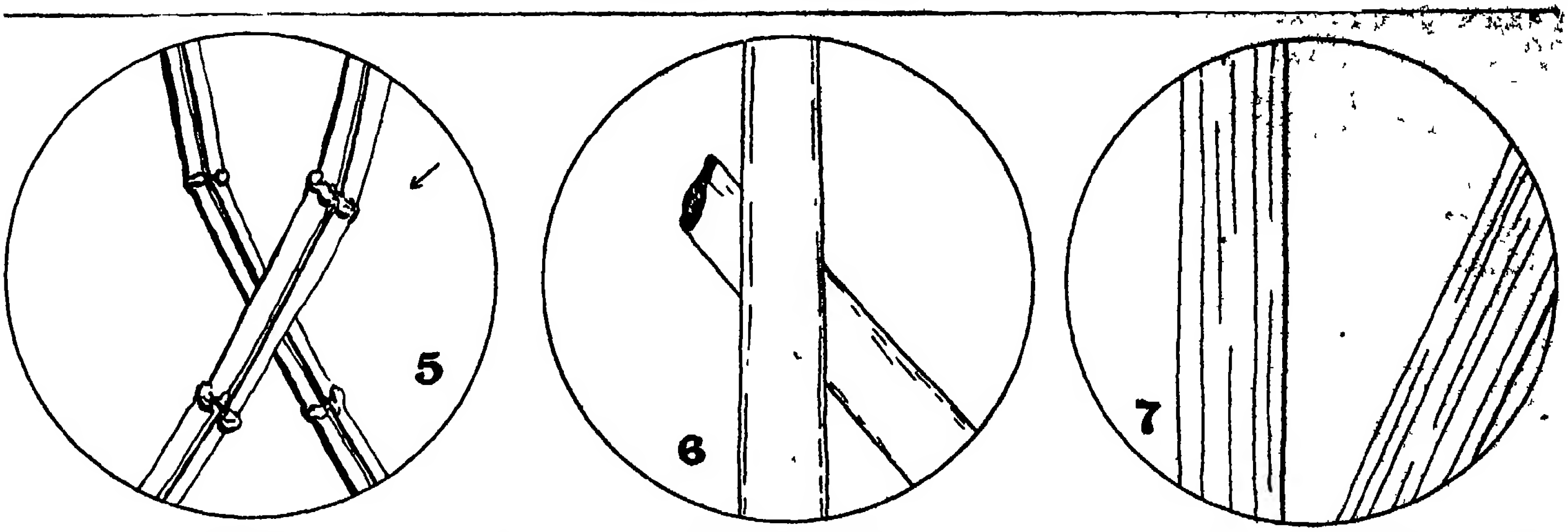
Fig. 4. Microscope, condensing lens (on stand) and microscope lamp arranged for examination of object by dark field illumination, using reflected light. Here the object receives light directed upon it from above

The equipment for the examination of mammal hairs and textile fibers should, for general work, consist of a good compound microscope, with a triple nosepiece, bearing a 16-millimeter, a 4-millimeter, and a 1.8-millimeter (oil immersion) objective, and being equipped with a complete substage attachment, including a special "paraboloid" condenser, for use in dark field illumination Furthermore, there should be available for use at least three eyepieces, or oculars, giving different powers of magnification with the different objectives, and an ocular micrometer for micro measurements A movable type of microscope lamp is a necessity, fitted with 'daylight glass,' and provided with other glasses of different colors A short focus lens or condenser is convenient, for concentrating the light where it may be needed There are other microscopical accessories which are convenient, and when once used, apparently indispensable, but the equipment mentioned above will serve all practical needs The slides and cover-glasses used are of the ordinary sort, and must be kept scrupulously clean Forceps, dissecting and teasing-out needles, scalpels, scissors, pipettes, and all manner of instrumental accessories can be multiplied *ad libitum*.

The commonest method of examination of textile fibers is with transmitted light This method gives good results in many cases, and yet does not bring out the delicate striations, or other characteristic markings upon which the identification of many of the fibers depends. In order to render these more clear, staining is often resorted to, yet this also is a more or less rough and ready method Striations, folds, grooves, etc, when lying in a beam of light parallel to the optical axis of the microscope *i e* parallel to that beam of light which enters the front lens of the objective and leaves the center of the eye lens of the ocular, are often almost wholly invisible This is not the case when the light from the mirror is oblique with reference to a line from the eye of the observer to the object under examination so that it illumines the fiber from one side and causes shadows to be cast by each depression or elevation Figs 1 and 2 illustrate the principles of vertical and oblique lighting when applied to the microscope

Oblique illumination can be modified in various ways to meet different needs It can be sent into the object on the slide either from the right or from the left from in back or in front of the stage aperture and at angles of varying degrees in any of these positions Colored light from the microscope lamp has sometimes been found useful for demonstrating markings, especially pigment patterns in some of the finer hairs used in weaving The color and intensity of the illumination, as well as the optimum angle of obliquity of the light rays are elements which must be worked out empirically for each specimen under observation

In examining certain fibers which it was desired not to stain and yet which, because of their uniform hyalinity it was difficult to illumine properly, the writer utilized a device which will be termed a *fiber compressor* (Fig. 3), consisting merely of a rectangular strip of heavy brass, bearing a circular aperture in its center The fibers designed for examination were placed upon a slide covered with a cover glass, irrigated with a colored liquid, and slightly compressed by placing the brass slide over the cover glass. The result was a group of fibers, showing clearly their outlines against



5. Fibers of linen from the winding sheet of an Egyptian mummy viewed by oblique light the arrow indicates the direction in which this fell. 6. American-made artificial silk of cellulose, viewed in safranin solution in the compressor 7 Italian-made artificial silk, seen under similar conditions

What the microscope shows us of textile fibers from various sources

a background of solid contrasting color In other words, instead of staining the fibers and examining them against a white field, the field was stained and the colorless fibers examined, against it This method proved very successful with such fibers as some of the artificial silks, where a *natural, not a stained*, appearance was the end in view The stains used for the fiber compressor were a saturated aqueous solution of safranin, of methyl green, of gentian violet, or of Bismarck brown These were made up and diluted to the required depth of color for each specimen Figs 6 and 7 show, respectively, American cellulose acetate silk and Italian made cellulose xanthate silk, both examined in the fiber compressor in safranin solution Various excellent differential lightings for bringing out a wide variety of markings in fibers can be had by utilizing the fiber compressor with both transmitted direct and oblique illumination, and various colors both of the light, and of the "background solution" or mounting medium of the fibers

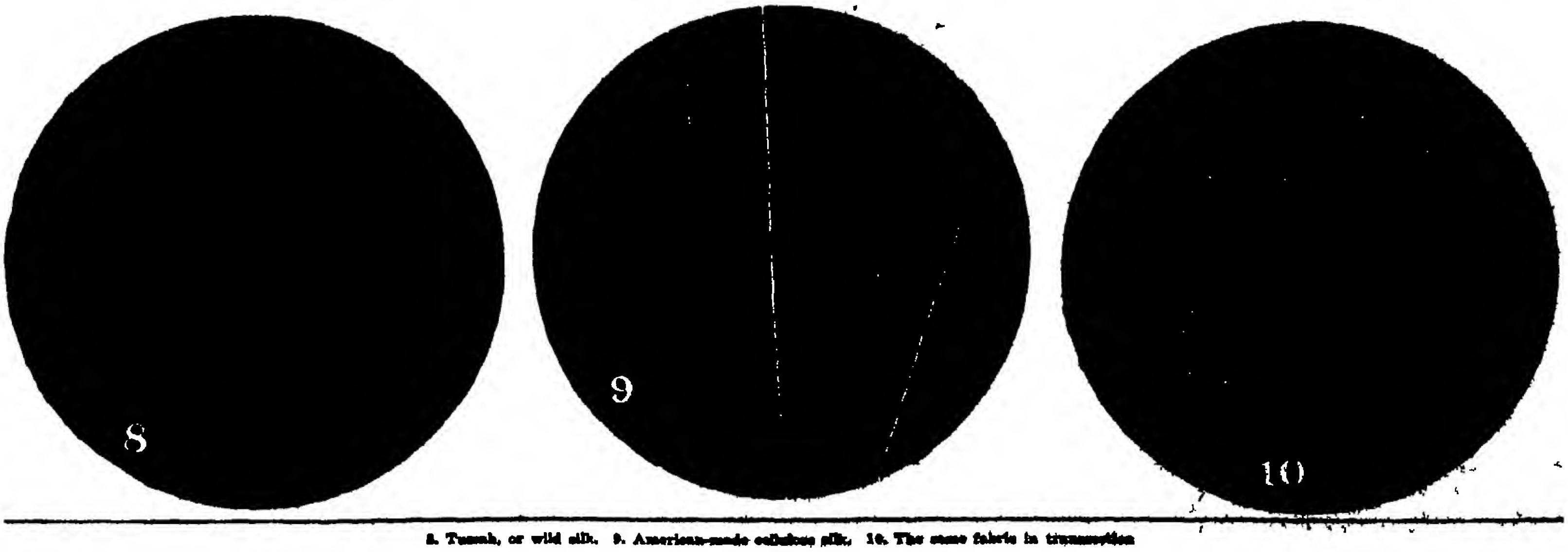
Dark field, or *dark ground illumination*, seems to be little used or little understood except by microscopists, and yet it is one of the most fertile methods of examination of delicate objects By dark field illumination is meant that form of illumination by which the object appears light and the background dark The appearance of objects under dark field illumination is much like that of the stars and moon against an inky sky at night In order to be available for examination under dark field illumination, the object must be mounted on a slide in a medium of different light refracting character, and must itself possess either strongly refracting, or reflecting qualities Such conditions are usually fulfilled by mounting any of the transparent textile fibers (*e g*, the artificial silks, natural silks, linens, etc) in Canada balsam, or some heavy oil, such as oil of cedar, or castor oil Only such light as is intercepted by the objects under examination, reaches the eye, hence the appearance of a brightly lighted object upon a black field

Dark field illumination can be had in several ways. The simplest method is to cover the aperture in the stage with a piece of black velvet (since this reflects so little light, even less than carbon paper), and then concentrate, upon the object on the slide, the light *from the microscope lamp, using for this purpose* a condensing lens mounted on a stand (Fig 4) With such an arrangement, a very small fraction of the light from the condensing lens is reflected back into the microscope tube while the object itself appears brightly illuminated *Such treatment works well, however, only* with those fibers which are more or less opaque, the transparent, glassy fibers demand a modification of this method This modification, designed for those fibers, which refract well, but do not reflect the light (such as the *transparent* artificial silks) consists in mounting them in Canada balsam, and illuminating them with the light from the substage mirror, using the dark ground stop, furnished with all Abbe condensers. With this type of dark field lighting, the object still appears light upon a dark ground. Figs. 8 to 10 show the appearance of various textile fibers under the two types of dark field illumination just mentioned.

Oblique illumination can also be made to yield somewhat the same results as illumination with the substage condenser and central stop, by swinging the condenser to one side, or removing it from its mounting entirely, so that only the stage, with its large aperture, remains. The mirror is now swung far to one side and turned so that its reflected light-beam reaches the object on the slide very obliquely If the light is sufficiently oblique, none will enter the objective except that which is intercepted by the object on the slide, which will, therefore, appear light upon a dark background This method possesses the disadvantage, however, that it can be used only with low powers, *e.g.*, with the 16-millimeter objective, and furthermore that the object itself is illuminated only on that side from which the light proceeds.

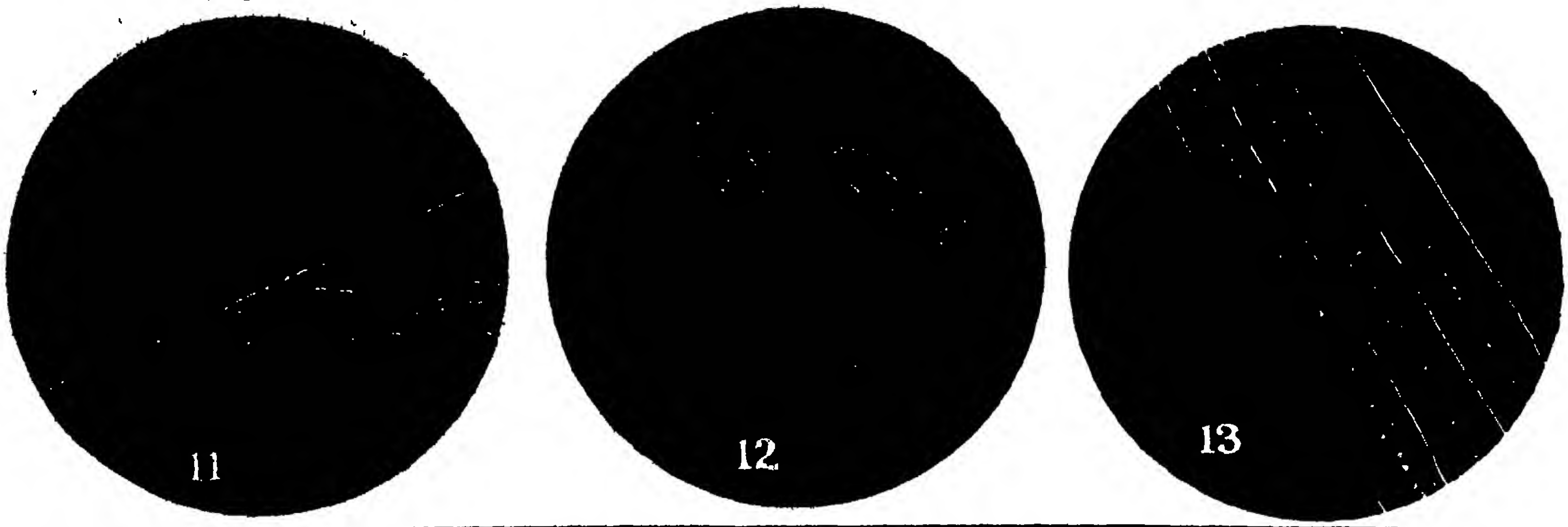
Excellent results have been obtained by a combination *of transmitted light (either vertical or oblique)*, and the first type of dark field illumination, in which the condenser on a stand was employed. With this type of lighting the fibers were mounted in some light oil (or glycerine, as has been recommended), such as *oil of amber, oil of bergamot, oil of cayeput, oil of* wintergreen, and oil of clove. Xylol and water were often also used as mounting media. The reagent which afforded the most satisfactory results, however, was oil of amber, with which the fibers were thoroughly saturated after having been washed (in the case of the natural fibers) with a solution composed of equal parts of ether and 95 per cent alcohol, or (in the case of the artificial fibers) with hot soapy water, to remove any oily matter from their surfaces. The velvet cloth was not used in this connection, as it would have interfered with the passage of light from the substage mirror Two sources of illumination were sometimes used, one above the stage for the condenser, and one below, for the mirror, and in this way light of different colors and varying intensities could be employed. Figs. 14 to 16 show various textile fibers subjected to this method of examination by double lighting.

For the permanent mounting of textile fibers, the



8. Tussah, or wild silk. 9. American-made cellulose silk. 10. The same fabric in transmission

Three dark-field views of silk fibers from different sources



11. *Jute.* 12. *Sea-island cotton in cross-section* 13. *Flemish flax.*

Three more dark-field exhibits

writer has found that Canada balsam and glycerine jelly answer all practical purposes. It is believed to be better, however, to keep textile samples filed away in envelopes, in a classified card-catalog system, and make preparations freshly when needed for comparison. In this way special methods of mounting in different media, for special methods of illumination, can be applied to each individual set of fibers, which would not be possible were they mounted once for all in Canada balsam or glycerine jelly Each set of fibers should be determined, the determination noted on the envelope, and the envelope filed away where it can be at once available. Each envelope should bear, moreover, an account of the treatment found best to bring out the characteristics of the fiber, on which indubitable determinations can be based

The enormous saving of time, labor and expense, together with the accuracy of the results of identification which microscopic analysis makes possible, should commend itself to all those who are working in the field of textile identification for the establishment of a system of uniform nomenclature of textile products.

Swimmer's Cramp—Its Causes and How They May Be Avoided

By J. S. Taylor, Captain, Medical Corps, U.S.N.

SWIMMER'S cramp is a spasmodic contraction of a muscle or group of muscles, as in the calves of the legs, the arms or the belly wall. Muscle cramp or tetanic contracture results from what is called summation of stimuli. The repeated and rapid contraction of a muscle induces fatigue and then temporary paralysis. The degree of fatigue necessary to produce spasm would, of course, depend on the tone of the muscle. A weak, undeveloped muscle would become fatigued sooner than a well developed one An important factor in muscle spasm is the accumulation in the local circulation of waste products incident to exercise known as "fatigue stuffs." These fatigue stuffs undoubtedly act as a chemical irritant to the muscle, increasing its susceptibility to tetanic spasm. Therefore, the activity of the local circulation is of immense importance in this connection

In Asiatic cholera the enormous reduction of body fluids by diarrhœa increases the viscosity of the blood and produces marked interferences with the capillary circulation. In this disease the patient experiences very distressing cramps in the muscles of the abdomen and of the calves of the legs.

Men who work in the hot firerooms of ships, especially inexperienced firemen, suffer from similar muscular cramps. They work hard drink a great deal of water, cold as they can get it, perspire profusely and often chill the body surfaces by standing half naked under blowers and ventilators.

With normal exertion of a muscle of good tone and with a normal circulation, tetanic spasm will not occur The weak muscle or the over stimulated muscle tends to spasm, and spasm is further favored either by an excess production of fatigue stuffs or by the deficiency of the local circulation on which the removal of these fatigue stuffs depends. In the case of the cramps developing in cholera the circulatory disturbance is the chief one The muscles are insufficiently nourished, enfeebled, and so predisposed to spasm from the smallest degree of exertion and the capillary deficiency prevents the removal of the chemical products of muscular contraction.

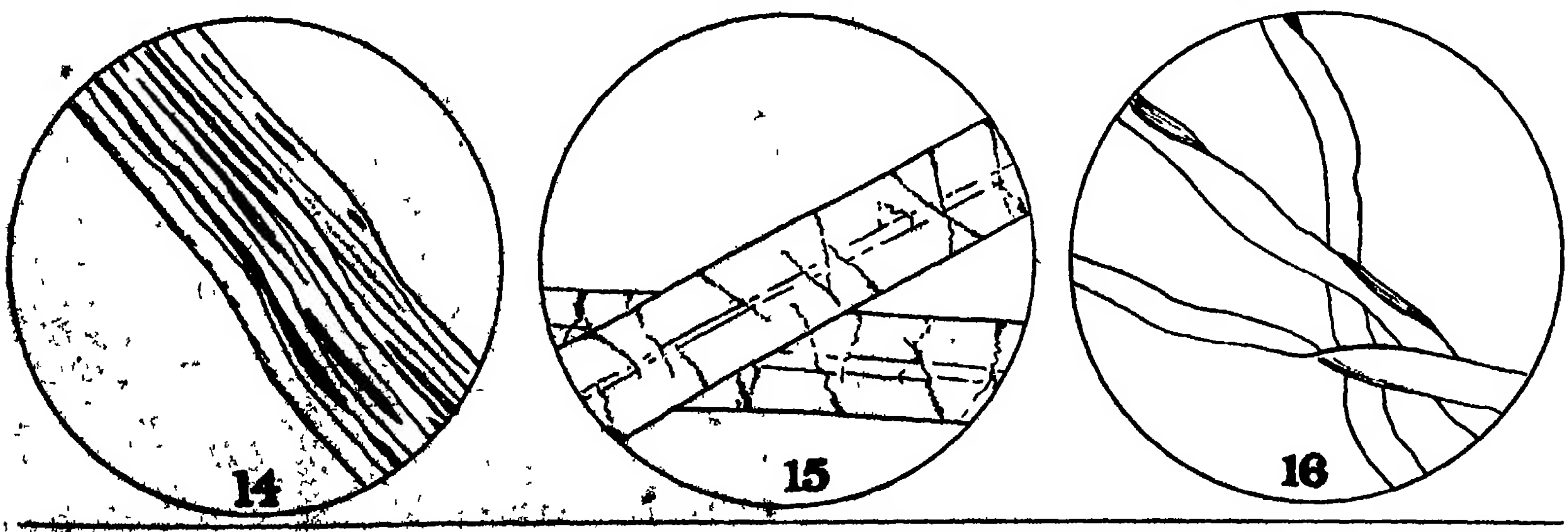
In the case of firemen, the over-use of the muscles and disturbances of circulation act together in producing cramps. The profuse sweating reduces the total bulk of body fluids and the chilling of the body surface along with the consumption of large quantities of water, tend to cause a congestion of the internal organs with a consequent collateral anæmia in the superficial blood vessels.

Practical conclusions to be drawn from these facts in relation to swimmer's cramp are simple Do not stand about at the water's edge too long before entering the water While it is a mistake to plunge in when the body is greatly overheated, it is just as bad to wait a long time to cool off first Do not go in swimming after a hearty meal or after consuming large quantities of water Several hours should intervene between a big meal and swimming

In the next place, when considering swimmer's cramp, it should be remembered that swimming is a very active exercise, calling into play nearly all the voluntary muscles of the body and it is easy to overdo The amount of exertion which can safely be made in the water without liability to muscle spasm depends in part on muscle tone The person who takes comparatively little exercise on land, whose muscles are more or less soft and flabby cannot reasonably expect to make undue calls on his muscles without unpleasant and dangerous consequences when he is exercising in the water

It is possible that swimming in very cold water may increase the tendency to cramps Even when exercising only moderately, most people stay in bathing too long, cramps may come from long-continued moderate use of the muscles just as readily as from excessive use of them for a short time

Considering the large number of deaths that occur annually through swimmer's cramp, more thought and care should be accorded this subject In many instances it is due to carelessness or lack of knowledge



14. [illegible] mulberry silk, in oil of amber 15. Purified French ramie linen, under the same treatment as the last. 16. Unmercerized cotton in oil of bergamot. Note the absence of twist

Three different fibers as seen under Dr. Hausman's double-illumination technique

Making the Flood Dam Itself

A Simple Wire Netting Structure That Gathers Mud, Boulders and Miscellaneous Debris to Form a Barrier

By J. F. Springer

ONE great idea being pressed today in the industrial world is automatic operation. Sometimes it can be fully realized. The raw material is then simply put in at one end and the work taken away at the other with the desired operations completed. Then there is semi-automatic operation when the full ideal can not be realized. Here there must be human control and attention for part of the operation. The civil engineers have not done a great deal along this line, so that when something of the kind is accomplished, it is all the more worthy of attention. A case in point is a rather novel type of dam that is being developed in California. This dam, once started, builds itself. As the initial construction is highly economic and the remainder is accomplished automatically, the cost of the finished affair is very moderate indeed. However, this type of structure is not usable everywhere, nor is the method universally applicable. But where the finished structure fulfils the demands and where also the conditions make the semi-automatic method applicable, we have a splendid result.

The Pratt porous dam installation after nominal flood. Note dead branches, leaves and other floating debris which have been caught and held by the skeleton-like structure

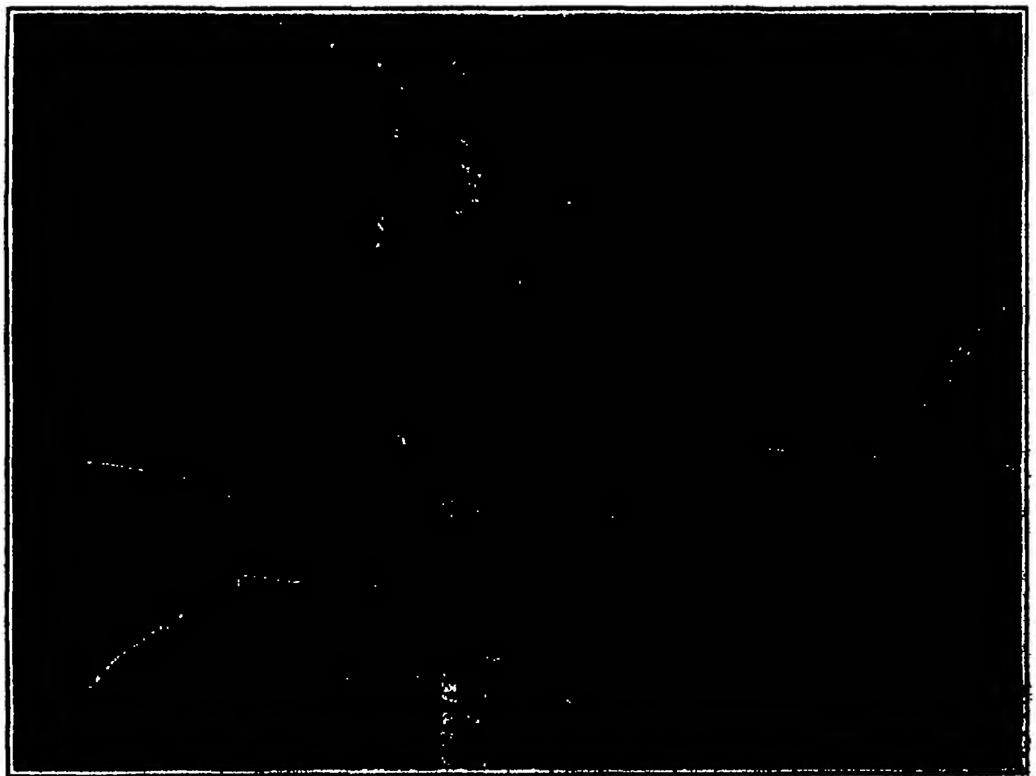
Torrential streams are rather famous for the trouble of which they are capable. They can be cured, and are being cured, but the usual method is rather expensive. The result is that but little is done, unless conditions are such that a profit may be secured by the use of the power water impounded. The upper reaches of the St. Maurice River in Canada have been put under control at great expense. But this expense is justified by the hydroelectric power stations downstream, whose operation is thus extended. Similarly, the Catawba River in the South has been put under limitations as to what it is permitted to do in flood seasons. But, aside from the insurance to property and life, the expenditures for the control works are expected to be warranted by the money return secured through conversion of the energy into electric current. Unfortunately, however, conditions are often unfavorable from the point of view of those who wish their money to earn more money. Investments from the humanitarian point of view are to be expected only from governments and philanthropists. Consequently, the development of a cheap type of dam suited to the purpose of checking the floods of a torrential stream might easily turn out to be a distinct advance in a humanitarian way.

The California dam, which appears to be the invention of Mr. A. A. Pratt of Los Angeles, is started on its way to completion by a simple skeleton-like construction built in part of materials close at hand. Thus, posts from the nearby woods may be set up at special points in the stream bed and these connected up by lengths of wire netting. Other forms of construction are permissible, if they seem preferable for particular cases in hand. The broad idea consists in the erection of a system of obstructions which are sufficiently open to permit the water to flow through rather freely, but which will nevertheless stop and retain floating debris, such as the dead branches of trees and other scrappings of the vegetable world. As these accumulate, the flow of the water becomes more and more impeded. The checking of the flow of running water carrying silt and the like tends to result in the deposition, first of the heavier particles and bits, and, as the retardation becomes more effective, of the finer and less heavy particles. The floating material is stopped and made to pile up and check the water, and this hindrance of flow results in filling in the interstices. Ultimately, what is the equivalent of a solid structure is produced. The water impounded upstream becomes more and more quiescent as the current slows up. Coarse and then fine sediment is deposited in the bottom of the pool. If the stream bed is rocky and bare, this deposition of sediment tends to fill in and cover up. After a time, however, if the flood continues, the top of the network will be reached by the accumulations, and the water will flow over the structure and continue on downstream. The dams are anchored further upstream for the purpose of holding them in place until their weight has sufficiently increased to prevent them being carried onward. It is said that, when once the basins commence filling up, there is no danger of a shifting of the stream bed.

These dams are built in systems. Thus a cross-section of the stream and bed may show on both sides a stepped arrangement from the bottom up. Then, there may be a second stepped arrangement disclosed by a longitudinal section. This latter arrangement suggests the terrace-like form of a natural rapids. There seems to be a rule which requires that the top of a dam shall not rise above the foot of the dam next to it upstream. It is to be understood that the foregoing sets forth only broad features. The space back of the porous dams may be cut up into rectangular compartments. Two sides of each rectangle may be made to parallel the current. The other sides will then be perpendicular to it. This compartment construction may be utilized to control the cross-section of the resulting impervious dam that the stream will build.

The terracing of the sides of the stream bed tends to confine the most rapid current to the center, and the less rapid currents to the two sides, the currents slowing up as the banks are approached.

Several years ago, a stretch of porous dams was constructed in the bed of Laurel Creek Canyon, near Los Angeles. Part of the region tributary to the creek having been burned over, the torrential character of the stream was increased. More water came and it brought a great deal of material with it. After the flood, it was found that the one-mile stretch of dams was in good conditions and that about one hundred of the secondary compartments had been filled with material. There was a protected channel about 25 feet wide.



Model installation of Pratt porous dams in Laurel Canyon, California. The grade of the channel is 5 per cent, while the width is 20 feet

Another porous-dam system was constructed for the Water Conservation Association of Riverside, California. The stream whose waters it was to control is a "contour canal." Next to it is a wide flood water channel. Most of the year the stream bed is dry. It is very rocky, being thickly strewn with small and medium sized boulders. A natural water basin lies below the upper strata in this region. It was desired to check the occasional floods and compel the water, or a large part of it,

to sink down into the water basin, from which it might be recovered and utilized.

A porous dam 130 feet long was built across a narrow place in the channel At one end a 40-foot wing set at right angles was constructed. There is one main barrier for the full length and two supplemental front barriers. Iron posts 3 inches in diameter or angle irons were planted in the stream bed and given a height above it of perhaps 6½ feet Wire guys were anchored upstream back of the posts and served to assist the posts in resisting downstream thrusts. These wires were perhaps ⅝ inch in diameter and reached back, say, 10 feet There might be several guys to a post, the conditions naturally ruling in the matter The anchorages were made to heavy boulders and were apparently sufficiently secure, as they withstood a flood in February, 1920 The upright posts were connected up by means of angle irons, and the frames thus produced were covered with wire mesh. This consisted of a fabric made of ¼-inch wire leaving 6-inch apertures. The fabric was, at the bottom, carried upstream for about 16 feet and the apron so formed weighted with boulders.

The February flood tried out the dam. After it was over, the structure was seen to be undamaged On February 22, the water was flowing over the top of the upper dam in a stream 4 feet deep. On the following day, the water had dropped 3 feet, but was of course still covering the structure.

It is claimed that the back-cutting action of the overflow from a built-up dam of this description differs from that which occurs in the case of the ordinary solid dam. The inventor says "After this mattress is completed, the overflow then acts exactly as it would in the case of the solid dam, with the difference that the back-cutting can only proceed to where it encounters the mattress previously built by the stream itself, when the menace ceases. With a solid dam, when the back-cutting reaches this same point, it connects with the water percolating from the reservoir and a channel is apt to be opened under the structure, which automatically enlarges until the solid dam fails."

The stream here resisted has a gradient of nearly 4 per cent. It may be almost or quite non-existent or it may have a depth of 4 to 8 feet and width of 500 feet Boulders and small pieces of solid matter are carried or rolled along by the swift current. Bed rock is everywhere out of sight near the location of the dam, covered up doubtless by the material brought to the spot and deposited in the years gone by

The foregoing account refers to a system patented by Mr Pratt June 4, 1918. A basic idea of the scheme contemplates the establishment of a central series of dams located along the longitudinal line of greatest depression in the bed of the stream These dams will be of short or moderate cross-section and do not seek to dam the entire stream In fact, each may be only a fraction of the cross-section of the stream in flood. The one located farthest downstream is set at any point considered favorable The next upstream from it will have its bottom on a level with the top of the first or perhaps a trifle lower The successive dams of the central series, as one goes upstream, will have their bottoms at the level or a little below the top of the next dam downstream in the series. This central series serves to locate and define the course of the stream at all times whether it is in flood or not To each side of it, another longitudinal series is also arranged The foremost dam in each series will be abreast of the leading dam of the control course, but set at a level such that its bottom will be at substantially the same height as the top of the dam in the central series. The next dams upstream in these side series will be similarly located with respect to the next dam upstream of the central line. And so on up the river. Other side series are similarly set up, the bottom of any dam in a transverse series being at substantially the same level as the top of the adjacent dam on the side of the center of the stream. The ends of dams are now connected with the ends of others downstream that are at the same level Compartments will thus be formed of rectangular plan The wire-mesh walls toward the center and downstream are at the level of the tops of the mattresses formed in the adjacent compartments. When the mattresses are all complete, the whole affair will be a series of steps whether one views it crosswise or longitudinally The stream will flow between two flight of steps.

The steps tend to become permanent elements in the stream bed because of the sand and other hard and imperishable material arrested by the mattresses of vegetable débris that form If there should be a poor natural supply of such débris, the deposition of sand and the like might have to be assisted either by using a closer mesh or by providing vegetable waste What is essential is that the water be checked in its flow, as this is the manner of getting deposits to form Of course, if there is quite a flow of small boulders, these may become an equivalent of vegetable débris. They will be halted by the wire mesh and build up a loose open pile This in turn will check the impetus of the water and bring about the deposition of sand and the like

After the flood. Receding waters have eroded the deposited sands in accordance with the layout of the structure. In fact, the channel is automatically self-cleaning

Some Simple Pointers on How to Keep a Car

By Harold Hollingshead

SOME people wonder why they are sick when they don't take a bath but once in two weeks, and some people wonder why their car won't run when they don't clean it but once a month, and then never touch the inside of the motor What we need is not greater motors, but drivers who will study the construction of a car and treat it as though it were human

The very first thing is a familiar warning—keep the inside of a motor free from carbon, but everybody does not know how to do it To start with, have the valves properly ground and adjusted and all carbon burnt out After this is well done, a teacupful of kerosene put through the pet-cocks twice a week will keep the motor in good shape After the kerosene is equally distributed through the various cylinders, the motor should be given about ten turns, either by hand or by using starter This will soak the entire motor with kerosene. Then apply the switch, giving the motor a medium amount of gas. In cold weather this remedy should be applied after the motor is warmed up, or in returning to the garage in the evening, otherwise the motor will require some skill to start After the motor is started and gets warmed up, running at a medium speed, open one pet-cock at a time, while motor is in operation, and you can notice the fine pieces of carbon coming out This kerosene can also be applied by using a small oil can, applying the kerosene through the air adjustment of the carbureter while the motor is warm and running at a medium speed, as the motor dies down. While kerosene is being applied, keep hand on the throttle of carbureter and increase speed

Another point is removing the plugs once a week and soaking them in a pail of kerosene overnight, then using a little emery on the points, drying them well, also adjusting all the points accurately to the thickness of a dime Then see that none of the porcelains is broken, which will cause a missing cylinder Also see that all the porcelains are thoroughly tightened by small nuts that are at the top of porcelains After this is done, each plug should have a washer and is thoroughly tightened in the cylinder head

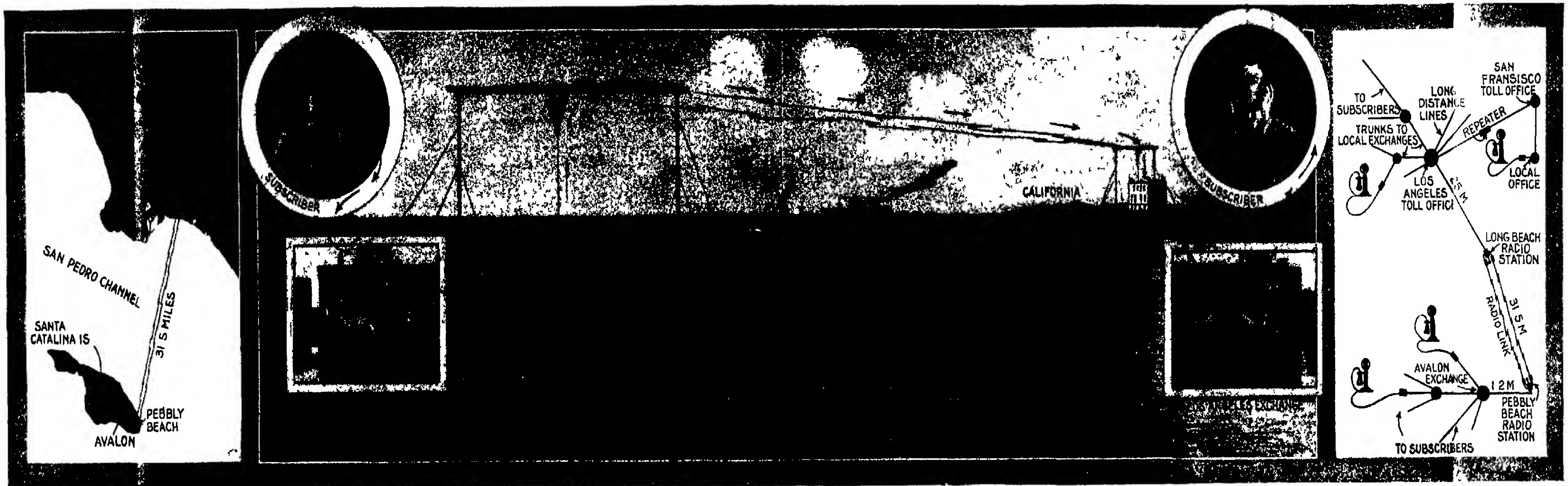
Most people have trouble with their motor heating up, and it is no wonder when the water that is in the radiator has collected so much rust and grit that it has shut off the circulation through the various cylinders This grit is removed by running the front of the car over a manhole or drain, while the motor is in operation You will find a small outlet plug at the bottom of the radiator on all makes of cars. After opening this, take off the cap from the radiator water intake and apply a hose with running water Let the motor run until the water from the outlet pipe becomes clear You can easily notice the collected rust and grit as it comes from the outlet pipe This operation once in two weeks, together with keeping the cooling fan well oiled and in perfect running condition, will give you a perfect cooling system

Oil should be drained from the crank case once in three months and new oil applied The same should be done in the transmission and differential cases, and these cases should at all times have the proper amount of a good quality of oil and grease An occasional application of neatsfoot oil to the clutch will keep it in good condition together with keeping the grease cup well filled

The brakes should be properly adjusted After jacking the rear of the car up, with the motor running in low gear, one man should operate the foot brakes back and forth, while another applies kerosene to the brake bands This will remove all grease and grit and give perfect action on the brakes. If the brake linings are badly worn and you want to come down a steep hill without relining brakes, apply hose of running water for about five minutes, soaking each brake lining in water This will expand your brakes and give you quick action for a short time Keep all parts of machinery oiled, and tires properly inflated to the proper number of pounds One drop of oil applied to the valve of the inner tube before air is applied will prevent any air from escaping from tire

A rag partially dampened in kerosene and oil is an excellent remedy to remove all sand and grit from the body To keep from scratching the paint on the body, great care should be taken to shake out the cloth thoroughly as you go along as this cloth will accumulate much grit, which is very injurious to paint After this is done, a clean piece of silk cloth from an old shirtwaist will wonderfully brighten up the paint

In driving a car do not advance spark on starting, or on a hill or heavy pull, or your motor will start knocking Restart your spark and you may not get the speed, but you will eliminate the knock and make your motor last twice as long and save your repair bill In running your motor idle, slow down to lowest possible speed This will keep the motor from heating up and eliminate the collection of carbon in the motor and will also save the gas bill In starting and stopping at all times shift to low or intermediate gears, which will save you the strain which would come on the motor by pulling in high gear



General arrangement of the radio link which connects the telephone system of Santa Catalina Island with the California mainland, together with a map of the territory served by the radio link and a schematic presentation of the radio link's role in the telephone system

The Radio Link

Extending the Usual Telephone Service by Bridging Present Gaps with Radio Telephone Installations

THERE is genuine romance in the story of the radio telephone. A dozen years ago it was a crude laboratory toy with little prospect of ever becoming a practical, workaday thing. It was handicapped with a most unsavory reputation because it had been made the catspaw of fraudulent stock-selling enterprises. The very publicity which had been accorded in unstinted measure had done untold harm, for the general public had come to expect too much of this young and quite unwieldy means of communication.

The radio telephone started out as a competitor of the wire telephone, although in truth it could never hope to rival the more conventional system. Yet the radio telephone only started on its practical career when the telephone engineers, the very men against whom this newer form of communication was to compete, took an interest in certain radio equipment, particularly vacuum tubes, and developed them to a practical point. Today the radio telephone is not a competitor of the wire telephone. It is an accessory. It became practical through the efforts of the telephone engineers but in turn it has made wire telephony possible over longer distances and with greater clearness than could ever have been possible with the former equipment.

The radio telephone today is part and parcel of our wire telephone system and it is fast becoming as practical as the latter. Indeed, were it not for the high cost of this form of communication it would be quite within present accomplishments for any telephone subscriber to call up a relative or friend on an ocean liner several hundred miles off shore, the voice being carried over the usual telephone line to the central office, through trunk lines to the distant radio transmitter, and thence transmitted through the air to the steamer. The radio link, as the radio telephone service is called when made a part of the usual wire telephone system, is destined to become commonplace within the next few years.

Now the foregoing is not a mere flight of fancy. It is a matter of record that the American Telephone & Telegraph Company recently conducted a series of experiments with radio links and the transcontinental telephone line. Telephonic communication was established between the steamship "Gloucester," cruising off Deal Beach, N. J., and Santa Catalina Island, situated some thirty miles off the California coast in the vicinity of Long Beach. The telephonic communication, in this case, passed from the "Gloucester" to Deal Beach, N. J., from Deal Beach to New York via telephone line, from New York to San Francisco via transcontinental telephone line, from San Francisco to Los Angeles via telephone line, from Los Angeles to Long Beach via telephone line, and from Long Beach by radio to Pebbly Beach, on Santa Catalina Island. From ocean to ocean via radio, telephone line and radio again!

The first commercial radio and connecting land toll line is the Santa Catalina Island and California radio link, which was set in operation well over a year ago. Radio telephone service between Santa Catalina and the mainland to connect up with the Bell System exchanges was installed at the request of the local telephone company. Catalina Island is one of the great tourist resorts in California. It attracts thousands of visitors daily throughout the year, who, heretofore, when they left the California mainland, remained completely isolated from the rest of the world until they returned to Los Angeles, except for a much-overloaded naval radio telegraph station on the island.

That this radio link, which bridges the 31½ mile gap between the island and the mainland, is not in the experimental stage may be gathered from the fact that it handles hundreds of messages each day. The large amount of commercial traffic with scarcely any interruption which the Avalon–Los Angeles toll circuit has carried every day since its opening, is an ample proof of the practicability of toll lines containing radio links, where, due to physical conditions, direct wire connections are impracticable.

It is virtually impossible to delve deeply into the intricacies of the Avalon–Los Angeles radio link and toll circuit, since it involves the most elaborate telephone and radio engineering practice. Suffice it to say that the diagram at the right of the above panel shows schematically the Avalon–Los Angeles circuit, consisting of a little more than one mile of wire line from the Avalon central office to Pebbly Beach, a 31½ mile radio link to Long Beach, and 25 miles additional wire circuit to Los Angeles. This combination wire and radio circuit is operated as a unit providing through telephone and signaling from Avalon to Los Angeles. At Avalon the circuit may be connected with any subscriber's line and at Los Angeles to any local subscriber's line through local exchanges, or with other long-distance lines reaching practically any subscriber in the Bell System.

The difficulties overcome to surmount interference from radio stations along the Pacific Coast and a naval station on Catalina Island, together with the many sets on ships, were many, we learn from the engineers of the American Telephone & Telegraph Company and the Western Electric Company, who installed the radio link. Practically uninterrupted service now has been made possible, however, and the quality of the transmitted speech is almost perfect, so much so, in fact, that a user of the telephone service that includes the radio link notices virtually no difference in the service.

Among some of the technical obstacles it was found necessary to overcome before satisfactory operation of the radio link was possible was the problem of housing the receiver and transmitting apparatus in the same building or in close proximity. This was accomplished by properly shielding all leads, shielding the receiver to prevent cross-talk from the transmitter, and the use of specially designed filter circuits for the receiver.

The radio link is, in truth, a link. It functions as part of the regular telephone system with little or no extra complication, so far as the everyday operation and use of the system is concerned. Operators are located at the central offices in Los Angeles and Avalon, operating ordinary telephone switchboards. They handle the radio link traffic in the same manner as if the wire circuits were being handled. They ring up in the same way by the operation of the usual ringing key. In fact, the installation of a voice frequency ringing system, which permits the use of a ringing key at the regular exchange switchboards in Los Angeles and Avalon, for signaling gave rise to some trouble and necessitated some changes in design before it was successfully placed in operation. This was due to the fact that the apparatus was rushed for the installation before it had been given a thorough field trial by the engineering department of the Western Electric Company.

The radio link is a duplex system, that is to say, one message may be sent in each direction simultaneously. For transmitting, a fair sized aerial is employed, as indicated in the accompanying bird's-eye view, while for receiving a loop antenna is used at each end. These loops are of the solenoidal type, six feet square, and consist of only four or five turns each. To make the duplex operation a success, it goes almost without saying that exceptional measures had to be taken, otherwise the transmitter at one end would drown out the incoming signals on the loop antenna but a short distance away. The elimination of such interference was attained by the use of different carrier frequencies for transmission in the two directions. Filters, amplifiers and repeaters are employed in large numbers, the basis of all this equipment being the improved vacuum tube. An interesting feature of the receiving apparatus is the provision of relays which close a buzzer alarm circuit when the filament of any vacuum tube fails.

The radio transmitter employed at either end makes use of a circuit in which the oscillations are generated directly in the antenna circuit. The modulation of the radio carrier frequency is accomplished by what is known as the "constant current system," in which both oscillator and modulator tubes are of 50 watts rating. These tubes are of the coated filament type, having relatively low filament power consumption and very constant operating characteristics. The transferring of the speech current from the telephone line to the radio link is an elaborate process. Briefly, it may be described in this manner. The speech current is applied to a speech amplifier tube, through an input transformer. The output of this amplifier is impressed on the grid circuits of the two parallel modulator tubes through a transformer. The action of these modulator tubes is that of an amplifier and their output voltage is impressed on the plate circuits of the two oscillator tubes by means of a reactance, which is common to the modulator and oscillator plate circuits. This modulation of the oscillator plate potential results in speech frequency variation of the amplitude of the antenna current. The frequency of the antenna current when not modulated is nearly that corresponding to the free period of the antenna circuit.

Since the radio link is the only telephone channel between the island and the mainland, it was very heavily overloaded from the day of opening until the cessation of the summer tourist traffic in the latter part of September, 1920. Due to the methods employed, the high grade circuit, and so on, a great deal more traffic is handled over this circuit than is generally handled by a single toll line.

A record of all of the interruptions to service is kept at both of the stations together with the cause of the delay, its duration, and other information. It is interesting to note that although the circuit was open to commercial service during the worst of the static season, subscribers had but little or no difficulty in using the circuit. Transmitting frequencies of 400 and 470 meters were chosen for the stations after an extensive survey of the ether, so that the telephone would cause the least interference to and be interfered with the least by radio stations in the vicinity. Some trouble was experienced from the Avalon spark station located about one mile from the receiving station at Pebbly Beach. This station employed a transmitting frequency of 300 meters, while the Pebbly Beach station had its receiving apparatus tuned to receive 470 meters. Upon investigation it proved that the wave emitted by the spark transmitter was a broad one, and that when the wave is kept sharp and within certain definite limits of purity, so to speak, little or no trouble is experienced from this station.

The circuit, due to the choice of sites, directional characteristics of the loop antennas, and selectivity of the radio receivers, is quite free from interference and it is only occasionally that an interfering spark signal is heard. The harmonics from the Poulsen arcs installed at the Naval Radio Stations at San Diego and Englewood, California, have given rise to some trouble. If the arc harmonic beats with the radio carrier and side frequencies of the radio telephone station at either an audible or nearly audible rate, the quality of the speech over the circuit may be affected materially. This is in effect the same result which obtains when speech signals are received on an ordinary heterodyne receiver when the local oscillator is not adjusted to the same frequency as that of the transmitter. Although this trouble can be eliminated as soon as it is discovered by shifting the carrier frequency of the radio telephone transmitter a few thousand cycles, it is obvious that in the future, when many stations may be expected to be operating, this difficulty must be eliminated in a more elaborate manner.

The radio link also provides for a full duplex radio telegraph circuit, capable of sending and receiving messages in two directions at the same time. Ordinary telegraph instruments are used at the terminals and ordinary telegraph lines lead to the radio installation. This duplex telegraph service operates simultaneously with the radio telephone with no interference whatsoever.

Electrostatic Adhesion Phenomenon and Its Application to Radio

AN interesting phenomenon of adhesion arising from electrostatic attraction was described before the Institution of Electrical Engineers by Mr. Alfred Johnsen and Mr. Knud Rahbek, of Copenhagen, who noticed in 1917 that strong adhesive forces were developed in some cases when an electric potential difference was applied between a solid body consisting of certain badly conducting materials—e.g., various minerals—and a conducting body, such as a metal disc, resting on the former body.

The adhesion was found to be due to a strong electrostatic attraction between the two surfaces in contact, and to be proportional to the true area of contact between the bodies, so that ground and polished surfaces fitting accurately together afford the best results. The solid materials in question conduct electrolytically and show a very high contact resistance with regard to an adjacent conductor, if no conducting liquid or cement be interposed between the two surfaces. The contact resistance can greatly exceed the normal resistance of the material used. If a potential difference be applied between the metal disc and a metal electrode cemented to the semi-conductor (as the material may be called) a weak current will flow through this semi-conductor and across the contact surface to the metal disc. This gives rise to an appreciable potential difference between the surfaces in contact, owing to the very high contact resistance, and the result is an unusually strong electrostatic attraction. The attraction between the plates of an "air condenser" for a given potential difference between the plates is proportional to the inverse square of the distance between the plates, and in the present case, the distance between the attracting surfaces being theoretically zero, an infinitely large attraction should be expected. In practice a smaller attraction is observed, the reduction being probably due both to electrolytic phenomena and to ionization; nevertheless, an exceedingly strong attraction can be obtained at moderate potentials.

It has been found that an electrostatic attraction of several pounds can be obtained between a thick lithographic stone, fitted with an electrode at the back, and a metal disc 2 in. in diameter resting thereon, when a potential of 440 volts is applied. The current is of the value of a few micro-amperes. The disc will lift the stone in a manner exactly similar to that in which an electro-magnet can be lifted by its armature, and the stone will drop if the current be interrupted. Similar qualities are exhibited by flint, agate, some species of slate, and many other minerals and salts, as well as by many organic substances, for instance, animal membranes, skin, gelatine, bone, etc. On the other hand, the experiment cannot be carried out with true insulators such as glass, mica, hard rubber, etc., as the necessary current cannot flow.

The considerable friction caused between the two surfaces by the attraction may be utilized for technical purposes by using the semi-conductor in the form of a cylinder which is kept in rotation and on which slides a metal band. As soon as a suitable potential is applied to the apparatus the band will adhere firmly to the cylinder and can be made to operate various devices, the whole forming an effective electrostatic relay. In connection with telegraph apparatus it is essentially useful as a radio recorder, the current from ordinary small valves being sufficient for its operation at a speed up to several hundred words per minute, if a sufficiently high potential (100 to 200 volts) be used for the valves. If the metal band be connected to a diaphragm or similar sound reproducer, and telephone currents be applied, a very loud-speaking telephone is obtained. A low tension pocket electroscope forms another application.

Research Institute in France

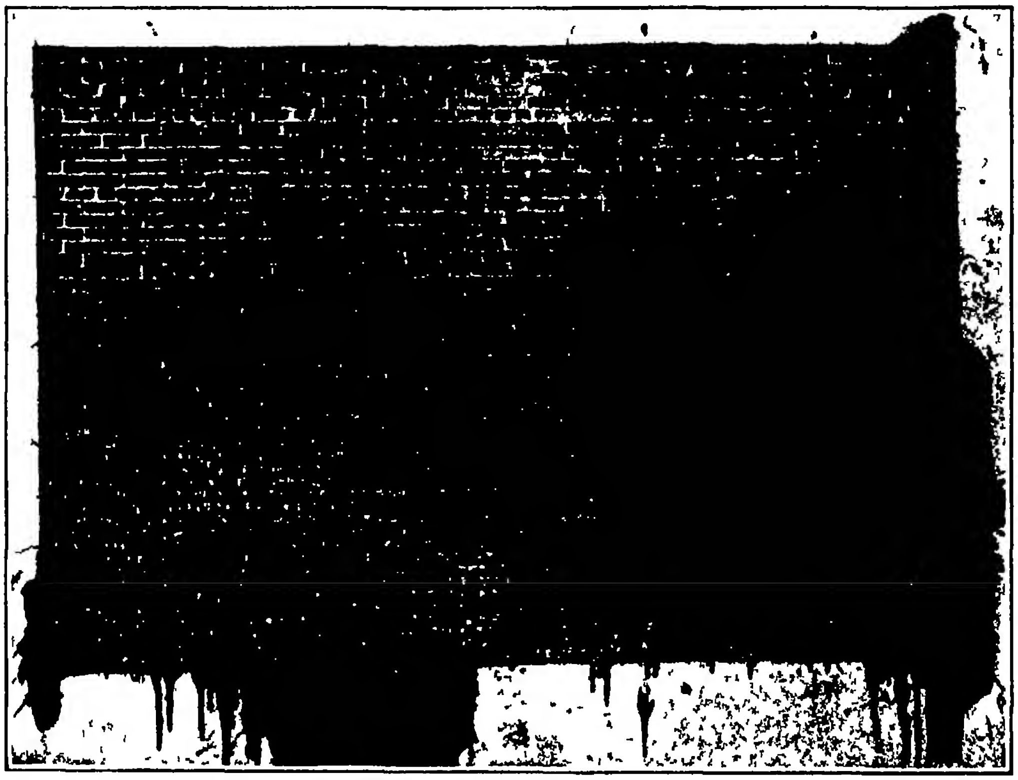
BARON EDMUND DE ROTHSCHILDS, administrator of the Eastern Railway of France, has given ten million francs to found a scientific institute, the object of which is to encourage students to take up research as a career. Particular attention is to be given to researches looking to the application of science to industry and agriculture. The institution is to be managed by a council, two members of which are elected by the Academy of Science and the French Museum.

Why Not a Nation-Wide Building Code?

Research Work of the Bureau of Standards with a View to Learning the Truth About Building Construction

By Geo H Dacy

RECENT house famine, housing congestion, building inadequacies and construction inefficiencies have rung up a reverse English bull's-eye to the extent that Government officials and authorized Federal agencies are now devoting serious study and thought to the matter of systematizing our haphazard, catch-as-catch-can methods, modes and measures of construction. In particular, Secretary of Commerce Herbert Hoover has interested himself in the satisfactory solution of our national building enigma. His efforts have resulted in the organization of a special committee of national authorities from the leading building trades and associated industries who, at this writing, are engaged in the formation and perfection of standardized building codes, plumbing codes, hardware codes and the like. In this work of uniformly standardizing the various building trades activities the national Bureau of Standards is cooperating and doing the majority of the testing and theoretical—as well as much of the interpretative and fundamental—research and investigations on building methods.



Brick wall, showing the fusion of the soft grades of brick at 2150 degrees Fahrenheit

Right now the Standards experts are comparing the requirements in building codes of some 300 cities in order—as far as is possible and practical—to standardize and unify these construction commandments and to formulate reasonable rules and regulations which will be the basis for potential and safe construction. There are approximately 450 cities in the country at present whose populations range from 10,000 to 25,000, that are not governed so far as building activities are concerned by standardized requirements. At least 65 per cent of these cities have no building codes whatsoever while the minor municipalities which boast any codes at all in some cases offer a sort of crazy quilt like, heterogeneous assortment of unrelated codes which dovetail together in about the same way that a square is related to a circle. Out of more than 300 American cities with populations in excess of 25,000 one-quarter have no building codes while the construction requirements enforced by many of the cities which have codes are variable without any apparent cause. The common plan followed in cities without orthodox building codes has been to use the State building codes, the fire underwriters codes, or the decisions and judgments of special committees of municipal authorities.

The Federal Government has no power in the matter of these building regulations otherwise than in an advisory capacity, as this work rests entirely with the different states and municipalities. The proposed standardization of construction requirements would be of outstanding assistance to the smaller cities which cannot afford the heavy expense of formulating definite local building regulations. Furthermore, such standardization would undoubtedly result in a marked curtailment in building costs and equipment installation expenses in many cases. The Bureau of Standards in reducing the matter of building code systematization to a workaday basis is conducting many worthwhile, unique and original tests and investigations. The results emanating from these experimental investigations are of basic importance in emphasizing many of the most significant factors in building codes which, heretofore, have either been ignored through ignorance or have been neglected through carelessness.

Practical, fundamental and essential tests are being made to ascertain the fire resistance of various types of wall construction. In one of the Government testing laboratories, large rolling steel frames have been constructed and are placed in succession directly above a series of powerful oil burners. Brick wall panels of different types 16 feet long 11 feet high and 8 to 12 inches or more in thickness are built in or close to this steel frame forming one side of the furnace chamber and, subsequently, exposed to flame action at high temperatures for long periods to determine their reactions to continued fire exposure. Generally, these test panels are fired continuously for about 6 hours or until they fall, or show excessive deterioration and injury. The heat generated by the oil burners is such that at the end of 1 hour, the temperature of the furnace is raised to 1700 degrees Fahrenheit, while it rises to 2000 degrees Fahr at the termination of 4 hours and attains the peak point of 2150 degrees Fahr at the end of 6 hours. At this latter temperature the less resistant varieties of brick melt on the inner face and pour down over the impaired panel as shown in the illustration above.

The steel frame used at the Bureau of Standards for the retention of the brick panels subjected to the fire resistance tests

The Government scientists and engineers in charge of these experiments measure the bulging and inclination of the panel walls towards the flames in order to determine under what conditions the fire is liable to cause the collapse of the brick walls. Various electrical indicating devices are used to measure the temperatures at different portions of the walls during the tests, more than 1000 such temperature readings being taken in the case of each wall panel that is fired. To date, the tests have included the tryouts of both solid and hollow brick walls of 8-inch and 12-inch thicknesses. The steel frame in which the brick panel is built and the panel itself when ready for test weigh about 25 tons and constitute the most ingenious method ever devised for exposing brick walls to fire hazards for experimental purposes.

In the solid wall panels 8 inches thick, 2200 bricks are used, while in the construction of the 12-inch test panels 3300 bricks are required. Where hollow brick walls are used, approximately 25 per cent less brick is used while the labor expenses in building the wall

are slightly lower than for solid brick, so it is reported

In general, the purpose of the laboratory fire tests with these brick walls is to determine the stability of the different walls, if they will buckle decidedly where exposed to extremes of heat and flame, and whether or not they will conduct heat to the extent that articles and goods stored on the opposite side of the wall will also be fired or damaged by the abnormal development of heat. The experimental panels are tested under two different conditions (1) With the walls under full restraint and built solidly in the steel panel, duplicating conditions that obtain in the lower floors of a tall building, and (2) with open spaces left around the top and sides of the walls to allow them to expand. This latter arrangement approximates the conditions which occur in light buildings and on the top floors of many buildings.

During the last 18 months, the Bureau of Standards has been assisting the National Lime Association, the National Association of Plasterers and the American Plasterers' Union to compile a standard plastering code of countrywide application. This work is now about half completed and promises potentially to modify radically existent deficiencies in plastering operations. Usually the average home owner becomes more familiar with the plastering and plumbing in his house than any other duo of the construction features. Uncle Sam's construction authorities and other national agencies are trying to standardize in black and white the facts and figures which will provide the householder with accurate information which will tell him whether or not his special job of plastering is good—and if it is bad, why it is unsatisfactory The Bureau of Standards has been conducting new and original tests and research activities with lime and gypsum to ascertain inside knowledge about these materials, which, previously, has been unknown. Plasters are made entirely of lime and gypsum which ordinarily have to be used together In most localities this means that one or the other of these materials has to be imported at considerable trouble and extra expense. Lime is used because of its plasticity, while gypsum is essential on account of its quick setting characteristics. Heretofore, the individual properties of these two materials gave no evidences of interchangeability How ever, the Government experts have already devised a system which gives plasticity to gypsum and a quick set to lime. These invaluable experiments will result in the future use of one or the other of these materials according to available local resources, but will not require the use of both materials to insure durable and satisfactory plaster surfaces. This means a big annual saving to contractors, builders and private individuals, and is the sort of worthwhile investigation which merits our hearty commendation.

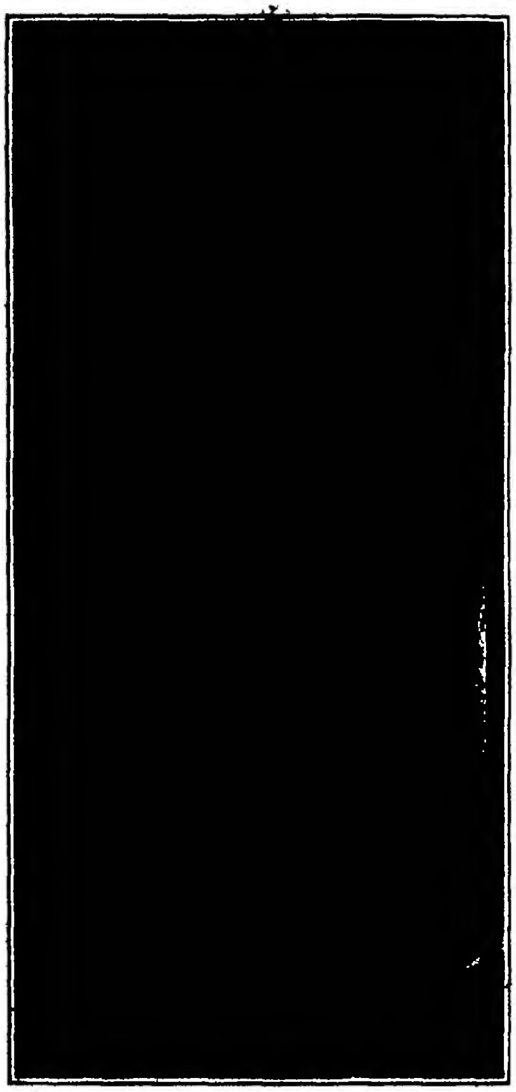
The Bureau of Standards has also evolved a method of coloring plaster so that attractive and ornamental wall finishes result, which eliminate the necessity for using decorative wall paper

Little is known about plastering sands by either the laity or building experts. The Government scientists are now conducting a detailed investigation of plastering sands in order to substitute definite facts and figures for our existent ignorance concerning the best types of this building material They are also devoting particular attention to the perfection of a method of making gypsum weatherproof so that it may be used as a finishing material on the exterior of buildings. Their efforts have been effective in a reduction of 50 per cent in the time devoted to the curing of sand-lime bricks and this has meant a great saving in production costs to the manufacturers of this material

At present, a special new laboratory is being equipped at the Bureau of Standards for investigating the effect of fire on different structural building materials. These tests show that timber weakens about 50 per cent in total strength when exposed to a fire temperature of 100 degrees Centigrade. At exposures of 100 to 150 degrees C., the timbers begin to give off light volatile materials, while at temperatures of 200 degrees C. they become soft and spongy

Structural grades of steel begin to lose strength when the heat register hovers between the 350 and 400 degree Centigrade mark, while at exposures of from 550 to 600 degrees C. steel fails under average working loads. If the temperature is increased to 800 degrees C. the very finest steel possesses only a small fraction of its original strength. The novel apparatus consists of a restraining frame of structural steel, a special loading mechanism and electric furnaces for supplying heat and maintaining the temperature uniform throughout the test specimen. Special temperature recording devices equipped with microscopic facilities for the efficient detection and interpretation of minutely sensitive fluctuations are used in this work. The importance of these fire tests is strikingly indicated when one stops to consider that destructive conflagrations annually cause property losses which aggregate over $300,000,000, an amount equivalent to one-fourth the total operating expenses of the United States Government, and which exceeds the annual appropriations of the United States Army and Navy

An electric ice machine capable of making one ton of ice daily is being used by the Federal engineers to chill an experimental chamber wherein all kinds of building materials are exposed to weathering conditions—laboratory duplications of the deteriorations and damages which obtain from the alternate freezes and thaws and the disruptive operations of Jack Frost In a single day's exposure in the cold chamber, a sample of building material such as sandstone, marble, granite, concrete or the like is subjected to the same number of climatic vicissitudes as it would undergo in one year's weathering The rock samples are first soaked in water



Solid brick wall tested free in the panel. The top of this wall bulged out 6 inches from the top of the pilaster, but sprang back after cooling

and then placed in the novel ice box and subjected to severe and extended freezing. Some of the samples are frozen and thawed 50 to 60 times which is representative of the deterioration they suffer under natural conditions in as many years.

Tests have been made of sandstone similar to that used in the construction of the White House and the National Capitol building When exposed to alternate freezing and thawing equal to 55 years of weathering, this material broke down and showed marked signs of crumbling. At the time when these Government buildings were erected, this particular variety of Virginia sandstone was popular and largely used for building purposes. The only reason why the executive mansion and the official headquarters for our national lawmakers have lasted so long is because both buildings are protected efficiently and well against weathering injury by regular applications of waterproof paint, which prevents the moisture from penetrating into the stone

Complete tests of every conceivable mixture and combination of concrete are also under headway as an important phase of the national housebuilding problem. The unique flow table designed and perfected at the Bureau of Standards some time ago for determining the consistency of concrete, is being used to good advantage in these studies Waterproofing and oil proofing tests of concrete cylinders are being conducted, records being kept of the penetration of cottonseed oils, fuel oils and gasoline into various mixtures of concrete Novel compression or crushing tests to ascertain the durability of marble slate, granite and other rock material for building uses are also in progress.

The properties of hollow building tile are being closely studied, this investigation having been in operation for about 12 months. Fire tests are being run of various kinds of tile emanating from different sections of the country

Extensive experiments have also been carried on to determine the most efficient and satisfactory methods of soundproofing the walls, ceilings and floors of apartment and office buildings. The early investigations have been so successful that work will soon be begun on the construction of a new, large and complete acoustics and sound laboratory where more varied and extensive tests will be run in the future

The proper, durable and efficient utilization of paint as a preservative and protector of wood has been studied in detail and results of interest and value to the average laymen have been obtained One common cause of the failure of paint is due to its application in unseasonable weather or due to the fact that it is applied on wet surfaces. The wood surface to be painted should be wholly dry and the weather should be dry and clear when the paint is applied In order for complete and proper adherence to the wood, the paint must be evenly coated over a moisture-free wooden surface In itself the thin layer of paint which is between 001 and 003 inches in thickness, affords but little protection and adds practically no strength to the surface where it is applied unless this work is consummated under the most desirable conditions. Light is one of the most destructive agencies which causes paint to deteriorate rapidly This explains why the dark-colored paints are more durable and weatherworthy than the lighter hues and colors, as the former materials are more opaque and cut off the light more efficiently to the extent that the light has less chance to penetrate to the oil which is the part of the paint which is most susceptible to early injury and decay One of the greatest economies in house and building decoration would obtain if the public could be educated against the use of white paint for exterior use. Just to show the damaging effect of light on paint, observe the north and south sides of a house that has been painted for some time Invariably, the paint will fail on the south side of the house before it begins to deteriorate seriously on the northern exposure, due to the larger amount of sunshine and light which concentrate their attack on the south side of the building

Uncle Sam's specialists are also conducting the most thorough series of experiments relating to the corrosion which occurs in building materials, that have ever been attempted Metal sheets of various materials used largely in construction work have been exposed to weathering conditions for periods of five years at three different stations in the country, which differ materially in climate

The Bureau of Standards has also carried on complete tests of all varieties of stucco During recent years more than 800 different panels of stucco have been constructed and tested out under actual building exposure conditions The panels—each of which was 15 feet long and 10 feet high—have been plastered with different combinations of cement, lime and gypsum, the common plastering materials. These panels were erected as part of the exterior walls of a storage building at the Bureau and have been under constant study and scrutiny since their completion Important facts such as the following resulted from these tests (1) Cracks which have occurred have not been due to settlement but to an improper method of sheathing, (2) Where hair was omitted from the first coat of plaster the lath is more completely imbedded, (3) The lighter shades of stucco show cracks less prominently after wetting than the darker shades, (4) The best method of finishing stuccos is to produce a rough surface such as the "rough-cast" or "pebble-dash" finishes, (5) Stuccos may be satisfactorily applied on monolithic, concrete bases and (6) No fundamental cracks have been identified over joints in tile, brick, concrete block or gypsum block.

The Bureau of Standards has also run a thorough test of more than 180 structural steel columns used in construction work

Lightening the Draftsman's Load

Labor Saving Devices That Go Beyond the Familiar Square, Triangle and Rule

By E S Van Brunt

THERE are on the market numerous ingenious devices designed to save time and labor for the draftsman Thus, a novel device for inking dot-and-dash lines consists of a triangle, T-square or straight edge (Figs. 1 and 2) with an intermittent groove cut in it just back of the edge, together with a small metal attachment which can be adjusted to the nib of any ordinary ruling pen This attachment when adjusted to the ruling pen travels along the intermittent groove, the uncut portion of which causes the pen to be lifted off the paper registering the spaces between the dots and dashes, while the cut portions form the dots and dashes. Triangles and straight edges may be cut with grooves to give any combination of dot and dash lines desired and best of all, the grooves do not in any way affect the edges for straight line work

A very convenient form of protractor combined with an ordinary triangle is shown in Fig 3. This device saves having two separate instruments to handle, and answers the purpose of a more expensive protractor for most of the ordinary work in drafting, the protractor being graduated to angles of 1 degree

Figs. 4 and 5 are "lettering angles" designed to give a quick and easy method of drawing accurately spaced guide lines for lettering drawings.

There are six columns of holes, the columns being subdivided into groups of three holes, while the holes of each group are joined by scored lines. The figure under each column denotes the height of the standard capital letters in thirty-seconds of an inch. The purpose of three holes in each group is to enable the drawing of three guide lines for each line of lettering, when it is desired to use both lower case and capital letters. The "lettering angle" is designed to slide on the hypotenuse when making standard spacings, but either of the other two sides may be used to get other spacings.

To use the lettering angle the pencil point is placed through a hole in the desired group and the angle slid along the edge of the T-square, of the ruler or of another triangle, the pencil point is then placed through another hole and angle slid back The lettering angle is moved along very easily by the pencil. The holes are tapered to prevent the breaking off of the pencil point. The guide lines are very accurately spaced and drawn much more rapidly than by laying off with scale and dividers.

The angles scored across the lettering angle enable one to obtain angles of 15, 45, 60, 75, and 90 degrees from either a 45 or 60 degree triangle, by setting these scored lines on horizontal or perpendicular lines of the drawing. The lines drawn at right angles and parallel to the hypotenuse are particularly valuable when sketching or doing work without the use of the T-square, because it facilitates very much the drawing of one line at right angles to another The lines on the lettering angle throw no shadows, whereas the edge of the angle does.

In Figures 6, 7 and 8 are shown several forms of section liners. These instruments are very convenient and useful where a large amount of cross hatching is to be done, especially if uniform spacing of the cross section lines is desired, as in plate work for reproduction. They are provided with adjustments which give a very good range of spacings for the lines.

The instrument shown in Fig 9 is a special form of triangle in which are combined angles for drawing lines of 15, 30, 45, 60, 75 and 90 degrees, an irregular curve, a protractor with graduations of 1 degree, holes for drawing guide lines for lettering and a scale graduated to sixteenths of an inch. For sketching, this is a very useful instrument as it saves having a number of different instruments lying around in the way

The universal drafting machine which is shown in Fig. 10 is, as its name implies, in quite universal use in large drafting rooms. It is one of the greatest labor saving devices for draftsmen on the market. It combines in one machine the T-square, the triangles, the scale and the protractor It is attached to the drawing board by means of an anchor piece fastened by screws rigidly to the board, the machine proper then being attached to the anchor piece The parallel motion obtained by the double arm always keeps the scales at the same angle with the edge of the board in moving them from place to place on the drawing. The edges of the scales are used as straight edges for drawing lines. The protractor scale is on the head, to which the scale carrier is pivoted This carrier is clamped to the head by means of a spring. By raising the spring with the thumb the carrier is easily rotated to set the scales at any desired angle. The whole operation is easily and quickly performed by the left hand, leaving the right free for drawing. It is estimated that in machine drawing 25 per cent of time is saved by the use of this tool, and in civil engineering work 50 per cent.

Another device making use of a parallel motion is the pantograph shown in Fig. 11. This instrument is used either for reducing or enlarging drawings, and is invaluable for this purpose. It consists of four bars joined together in the manner shown. The instrument is pivoted at one corner to a weight or fixed standard. At another corner a tracing point (A) is provided, which is moved over the outline of the drawing to be reproduced. The motion of this tracing point is transmitted to the pencil point at B by means of the parallel motion, causing it to describe exactly the same outline as followed by the tracing point A. By changing the length of the bars and shifting the pencil point any desired proportions (within the limits of the machine) may be obtained.

For drawing ellipses, the instrument shown in Fig. 12 is very useful and convenient. It consists of a triangular frame mounted on three legs, in the lower end of which may be placed needle points to hold the frame from slipping when in operation. On the rods A and B of the frame are mounted two carriers, C and D C is so mounted that it is free to slide on rod A and D is free to slide on rod B In a bearing on carrier D is mounted a vertical shaft E, the upper and lower ends of which form clamps for carrying the graduated beams F and G At one end of F is mounted a pen or pencil point P, while at one end of G is a pin K that is pivoted in carrier C and to which the operating piece O is attached The handle H is for holding the instrument when in use.

To draw an ellipse the beam F is adjusted in the clamp and secured with a set screw, so that the distance from the pencil point to the center of E is equal to one-half the length of the minor axis of the ellipse. In a like manner the beam G is adjusted so that the distance from the center of pivot pin K to the pencil point is equal to one-half the length of the major axis. By giving the operating bar one complete turn a perfect ellipse mathematically correct, is obtained. With the ellipsograph shown in the figure ellipses up to 5x9 inches in size may be drawn. Circles may also be drawn with the above instrument, by placing the center of pin K directly over center of piece E.

The beams F and G are graduated to facilitate the setting of the lengths.

Another great labor-saver is a device for stamping titles, lettering or designs on tracing cloth. It is useful only where the same lettering or detail is repeated on a number of different sheets—as titles or standard details that repeat often. It consists of first making an impression with an ordinary rubber stamp, inked from an ink pad as usual, and while the impression is still moist applying to it a small amount of a specially prepared black powder The surplus powder is then brushed off, leaving the impression jet black and clear So as to remove any of the black powder sticking to the tracing other than on the design, the impression is washed with gasoline, and then a second, but this time a white powder is sprinkled on the design and rubbed for a moment with the fingers, when the design, lettering or standard details will be jet black, gasoline-proof, smear-proof and ready for use, blue-printing perfectly. This process requires but a few moments and gives perfect results.

Steel Direct from the Ore

PRESENT day practice in the steel industry of practically the whole world is to smelt iron ore in a large blast furnace, thus converting it into pig iron. The next step is to transform this pig iron into steel by remelting the pig iron or taking it hot as it comes from the blast furnace and transforming it into steel by any one of the standard processes. This practice of employing the blast furnace means really the reduction of the iron ore to iron with which there is mixed three to four per cent of carbon. The conversion of this iron into steel means the removal of most of this carbon again, for steel is iron with but a small quantity of carbon in it. Present world-wide practice then is reduction of iron ore to metallic iron, putting in a large amount of carbon and then taking it out again.

From this it is readily recognized that if some process could be devised which would eliminate the necessity of the carbon, the whole steel-making method would be revolutionized. This has been the dream of many scientific men for many years. Translated into plain language this means a method of making steel direct from the ore instead of what most regard as the indirect process now used.

The public and technical press has been quite alive recently with various articles on this subject in which new processes and patents have been aired extensively. They originate in foreign countries as well as in the United States. The principle of all of them is the treatment of iron ore, usually in a finely divided condition, with coal or coke, also finely divided, in a special furnace heated with some reducing gas or other fuel so that the iron ore is reduced or separated from its oxygen and the iron converted into a metallic form known as "iron sponge." This is relatively pure iron except for the original impurities in the ore and it contains practically no carbon. Its conversion therefore into steel direct would be a comparatively simple matter except for the fact that the iron in the form of iron sponge is easily reoxidized by the air when hot and, as it is always hot in such a process, this circumstance has interfered with its conversion into steel. Recent patented processes claim to have overcome this prominent drawback.

It is not possible in a short article of this nature to enumerate in detail the various processes that have been proposed. The most important ones by names are the Jones process, the Bourcord, the Lang (American), the Basset (French), and the Moffat (Canadian). A brief analysis of each of these was published in the SCIENTIFIC AMERICAN MONTHLY for July, and more detailed descriptions have appeared in *Iron and Steel of Canada* and the *Canadian Mining Journal*. They all aim at the same object and differ in apparatus for reducing the ore and handling the iron sponge. Some claim to have been successful in preventing the oxidation of the sponge and in producing steel economically Most of them use electric furnaces to complete the melting and refining of the iron sponge into steel.

The great drawback to any direct-from-the-ore process for steel is the cost as a competitor with the blast furnace or present methods. It is claimed that the former can never compete with the latter In some localities, such as Canada or California, it may be possible to use one of the new processes, but not where the blast furnace is now used. Some day such a process will probably be perfected but it will probably be many years. It is not safe to condemn it offhand for stranger revolutions in metallurgy and in other industries have been wrought, and the unexpected or even unexplained of yesterday is but the commonplace of today and tomorrow.

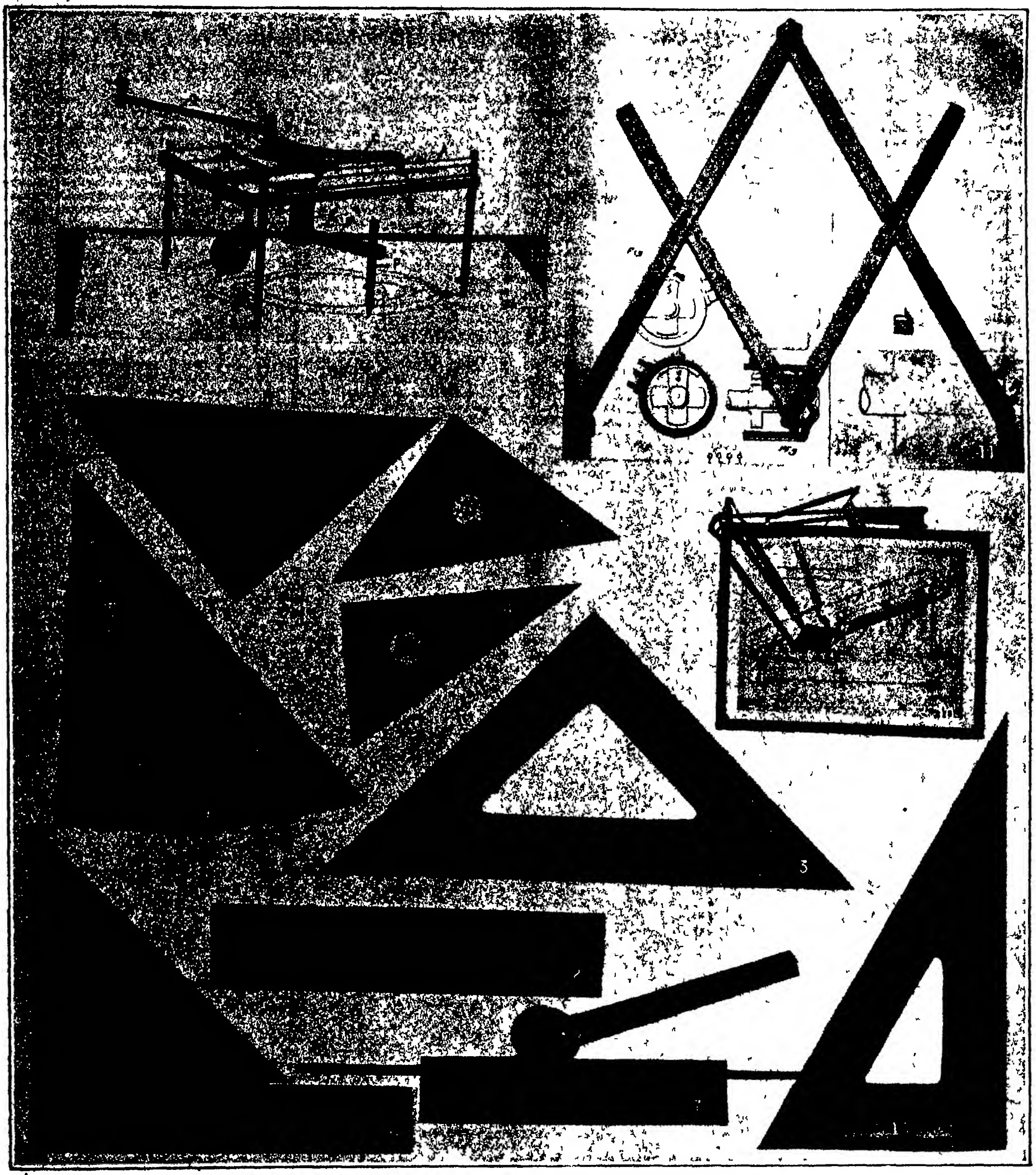
A Gravity Spray System for Orchard

IN the Wenatchee fruit district of Washington where many of the orchards are on land with a considerable slope, a new system of spraying is coming into use. The previously adopted method, which is still, of course, the prevalent one, is a portable power sprayer which moves about the orchard, the pumped liquid spray being applied through a hose. The new method dispenses with the portable equipment, and substitutes a "system."

Thus at Sunnyslope in Wenatchee, on the Moss ranch, a 1000-gallon tank for holding the mixed spraying material has been established at the upper end of the orchard, which is on a marked slope. From this tank a system of underground pipes runs. There is a pipeline to every four rows of trees. Two hundred feet apart on the pipelines are taps.

In spraying, a hose 100 feet long, attached successively at the various taps, enables the worker easily to cover the whole orchard. The fall from the storage tank gives sufficient force. In another local instance, where the fall in the orchard is not sufficient of itself properly to distribute the solution, a small pump is installed at the tank.

Where gravity is the sole force for distributing the spray, this system saves engine and fuel expense. It is found a marked labor-saver, and is of special importance in these days when [illegible] Wenatchee [illegible]



1. Triangle with alternate notches and ridges along the edge, so that a pen with a metal extension piece that runs over the surface of the triangle will draw a dotted or dashed line. 2. Rule with sliding arrangement. 3. Protractor combined with the ordinary triangle. 4, 5. Lettering angles: a pencil held in one of the holes will draw a guide-line for lettering when the triangle is slid along on its base. 6, 7, 8. Section liners for producing cross-hatching of more regular character than can be drawn ordinarily 9 Triangle with all angles that are multiples of 15 degrees, and in addition a universal curve, a protractor, guide line holes and a scale. 10. The universal drafting machine, a single apparatus that does the work of all the familiar tools. 11 The pantograph for automatic copying on enlarged or reduced scale. 12. The ellipse machine.

Some of the ingenious devices that are now available for lightening the draftsman's load

A Study in Offspring Herds

What the New York Zoological Garden Has Done in the Way of Supplying Bison and Deer to Others

By Dr William T. Hornaday

THE New York Zoological Park located in the beautiful Bronx Park of New York City has already an enviable record as the mother of herds of wild animals elsewhere After twenty years of varied activities it is well worth while to indulge in a look backward to see what has been accomplished

By a strange combination of circumstances, the Park's first achievement has proved to be its most important one It resulted in the founding of the Wichita National Bison Herd in southwestern Oklahoma

In 1905, the creation by national action of the Wichita National Forest offered a golden opportunity to establish a bison herd in that region The New York Zoological Society approached the U S Department of Agriculture with an offer to present to the Government a carefully selected herd of fifteen pure-blood bison, and deliver them to Oklahoma, provided the Government would furnish a satisfactory range fence it securely and maintain the herd

The offer was immediately accepted by Secretary Wilson, the Society selected the range and proposed its boundaries, and the range was established in close conformity to those plans. In fact, everything was made quite satisfactory to the Society Mr Frank Rush a Colorado cattleman was selected as warden for the new bison range and custodian of the herd.

In 1907, when all was in readiness the Zoological Park authorities selected fifteen of the best bison in their herd of about thirty five head, choosing good breeders and young animals fit to become successors of the adult members of the new herd There were seven males and eight females, of various ages. By H Raymond Mitchell, chief clerk of the Park and Frank Rush, the bison were personally conducted to Cache, Oklahoma, and finally landed in safety and good condition in the corrals of the new range

Previous to shipment, outbreaks of Texas fever in Oklahoma emphasized the fact that the new bison range was in the Texas fever belt, and solemn warnings came to the director of the Park that the dread disease would kill the bison In Lawton, Oklahoma, bets were offered that not one bison would survive the first year As in many other cases, the director of the Park had to assume the responsibility and the risk of action He felt that the U S Bureau of Animal Industry could safely be relied upon to show Mr Rush how to save the herd from the Texas fever tick so the risk was taken

During the first year that the gift herd spent in Oklahoma, two of its members died of Texas fever, and one young animal was accidentally killed. After that, the commendable diligence of Warden Rush, aided by advice from the Washington Bureau, soon got the situation completely under control and permanently stamped out the Texas fever menace

The Wichita National Bison Ranch, selected by J Alden Loring, acting as the Zoological Society's agent, proved absolutely ideal for its purpose The bison herd has thriven marvelously Without any additions from without, it had increased to a total on January 1, 1920, of 116 head

Concerning the quality of this herd, we are content to cite only the testimony of Mr Charles Goodnight, one of the pioneer buffalo and catalo breeders of America, whose herd at Goodnight, in northern Texas, is famous throughout America After a visit to Mr Rush and his Wichita herd, Mr Goodnight wrote to Mr Edmund Seymour president of the American Bison Society, that 'the Wichita national herd is the finest captive herd that I ever saw"

That herd now is being drawn upon by the Government for animals to go elsewhere to help establish other herds.

Naturally, the withdrawal of those fifteen choice animals from the Zoological Park herd was a severe blow to it Those animals would not have been sold for other purposes at any price, but it was felt that the founding of a new national herd, at an ideal spot, for the perpetuation of the species, justified the supreme sacrifice that was made.

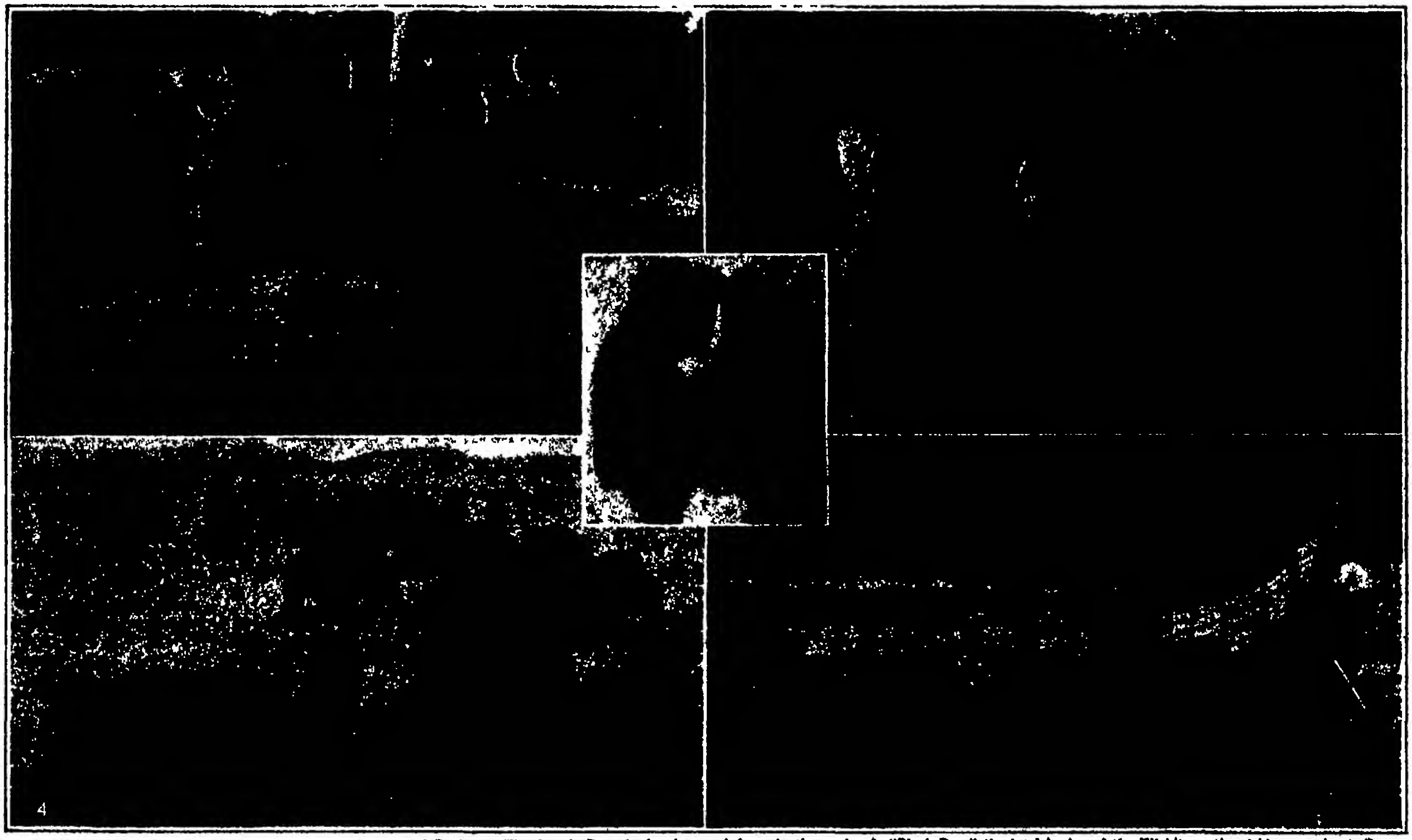
In 1913, the great success of the Oklahoma experiment led the Zoological Society to repeat it for the creation of another national herd. In Wind Cave Park, southwestern South Dakota, the Government cheerfully coöperated with the American Bison Society in a new bison enterprise This was undertaken through the initiative and the efforts of the late Dr Franklin W Hooper, then president of the Bison Society, who pledged that the Society would furnish at least ten gift bison if the national Government would do the rest.

This time the Society furnished fourteen head, and the Bison Society provided for their transportation. The more rigorous climate of South Dakota kept the gift bison busy for a full year in getting settled down in their new home and well started in breeding; but after that the course of the herd ran smoothly. Now the herd contains over 48 head, of quality very satisfactory for the founding of a new bison unit.

Dr T S. Palmer of the U S Biological Survey now calls the Zoological Park bison herd "the mother herd"

And there is a third herd to the credit of the New York Zoological Society It is in Denmark, at the Copenhagen Zoological Garden. It sprang from a pair of breeding bison bought from us by Mr Nelson Robinson and presented to the Danish zoo. Our last information reported six head.

Several noteworthy herds of deer have arisen from beginnings drawn from our parent stock. The first one was due to enterprise of the late Dr. Ray V Pierce, who, during the last years of his busy life, owned and lived upon St. Vincent Island, just off Apalachicola, northwestern Florida. Of all the places



1 The European red deer herd in the New York Zoological Park. 2. The female Barasingha deer and fawn in the park. 3. "Black Dog" the herd leader of the Wichita national bison herd. 4. Part of the Wichita national bison herd on its Oklahoma range. 5 Crating the original Wichita bison herd in the Zoological Park

Some of the deer and bison of the New York Zoological Park, from which have sprung offspring herds elsewhere in the United States and in Europe

that we ever have seen in the South, St. Vincent Island is the most beautiful, most interesting and most perfectly adapted to the requirements of an ideal game preserve and private hunting-ground. It is highly diversified, both in its forestry, its vegetation and its land and water. If any king ever had a hunting ground like that, he was luckier than most kings of my acquaintance.

To hunt and kill a desirable wild animal on St. Vincent is a man's job, as I can testify. When Dr. Pierce proposed that we should go out and kill a wild bull for beef, I assented languidly, in the belief that it would be a cinch. Now I say, let him who thinks so try it once—that's all! We wounded a lusty bull, and we chased him through the jungle for five straight hours. When the bull finally dived into an impossible swamp, our tongues were hanging out, and we were proud and happy to give up beaten. We were five miles from the hacienda, and so dead tired that when the doctor sent a wireless S O S message by Sam, we filed no objections, but cheerfully waited for a trap to come and haul us in.

The bull was found dead, a week later.

The island contained white-tailed deer, and Dr. Pierce wished to have a larger species. We suggested Indian Sambar deer as a promising experiment. Any and all of the deer of the Sambar group should do well in the South, and produce much good venison. Dr. Pierce bought a trio from us, a fine buck and two does, and in every way did the right thing by them.

But the buck went wrong, for some reason never known, and died in the first year, leaving no children. The next year another buck was sent down. Some offspring resulted, but the increase was not what we had a right to expect. The Sambar now on the island are very wild and shy, and no one can say how many there are, but Dr. N. Mott Pierce writes that the number has increased rapidly and the deer are now plentiful.

It is the fine size of the Indian and Malay Sambar deer that render them desirable for colonization in the South as food producers without artificial food. Of course there are thousands of localities so barren that they could not exist without being fed, but there are also others wherein Nature supplies all their wants.

In quite the opposite direction our herd of European red deer founded an offshoot herd that now is a going concern and a complete success. When Mr. John B. Burnham, the famous president of the American Game Protective and Propagating Association, decided to establish in the North woods of Essex County a fenced deer preserve of 750 acres, and our advice was asked, we recommended as best for his purposes the red deer of Europe. It is smaller than the elk and not one-quarter so troublesome; it is hardy and prolific, and the bucks are not the dangerous brutes that many white-tailed bucks are in the breeding season.

Our suggestion was adopted, and Mr. Burnham drew his nucleus stock from our herd. From the very first moment his experiment has prospered and proven satisfactory. The beginning was made in 1912 with four animals. Since that time many fauns have been born, and the herd has thriven, but for certain good reasons, Mr. Burnham is not satisfied with the red deer as an animal for a small preserve. He writes me as follows regarding his herd:

"The red deer stand the extreme cold of northern New York where the thermometer sometimes drops to 40 deg. below zero without apparent inconvenience. We are in a country of light snowfall, but in exceptional winters have occasionally got from three to four feet of snow. Under those conditions the red deer never yard, and as they are good providers they will live even under conditions where a white-tailed deer would starve. I do not, however, like them as a park animal because they are gross feeders and break down a great deal of small growth which dies and is wasted as a source of food supply. They also eat the bark from several kinds of trees and are, therefore very different in their feeding habits from our native deer, which are dainty browsers. Where their range is limited the destruction of food is an important asset on the wrong side of the ledger. Therefore, I am getting rid of the deer and at the present time have only four or five of these animals in my park."

In order to visit a herd of barasingha deer (of India) that we recently founded, it will be necessary to cross a bit of blue water. A French gentleman living in the island of Martinique desired a herd of deer suitable for that island and climate. We recommended the barasingha species, and the suggestion was adopted. We sent forward a breeding trio and in the first year the nucleus herd doubled itself. The owner was delighted, but I have secret fears that ere long he will awaken to the fact that he has more deer than he can well manage, and will be bothered by the surplus.

The barasingha is a beautiful deer of middle size—next below the red deer. It is a good breeder, but nervous and flighty in temperament and difficult to ship without accident. Its summer coat is a bright old gold yellow.

The bison, deer, tapir, aoudad and other hoofed animals that we have sent to other zoological gardens and parks we do not count, for we do not think of them as being on a herd basis all of our own making. As for the inbreeding bugaboo, that is another story. For healthy wild animals living naturally in great open ranges there is (in our firm belief) absolutely no evil to fear from inbreeding. This belief is the result of twenty years of close observation of the big game of the world, and the accumulation of many facts.

Linotype Slugs and Catalogues

Printing a University Library Catalogue from Linotype Title-a-Line Slugs

By Howard S. Leach

Reference Librarian, Princeton University

FOR the first time in the history of libraries a catalogue of a large university library is being printed from linotype title-a-line slugs. This catalogue is the outgrowth of a Seminary Finding List, started over 20 years ago. It has been a natural growth, fostered by wholesome demands from university professors for an ever larger scope of usefulness. At first the Finding List contained only such titles as were congregated from the main stacks and reading room in seminary rooms for special advanced study purposes. A demand from the Mathematics Department for a printed catalogue of all mathematic books owned by the library, without regard to location, removed their Finding List from the category of a simple seminary list to a complete catalogue of the books pertaining to a university department. A slug was made for each book on mathematics in the library and a catalogue printed. In like manner, lists were printed for philosophy, Germanic languages, music, European war, etc., etc. The printing of these larger catalogues for departments lead naturally to a cumulated Author Finding List, embracing all seminaries and most of the outlying departmental libraries, and a copy of this was placed at each point of use. The cumulated list contained 628 pages. Demands came for fuller lists from time to time until the work reached a point where not a great many books remained in the general library for which there were no slugs.

The printing of a title-a-line catalogue for the entire library was begun in September, 1919. Slugs were made for such books as still remained without them, and the printing went forward.

The first half of this catalogue will be in classed or classification order, which, like the shelf list or official catalogue, brings all regularly classified titles on a given subject together, regardless of their location in the building. In other words, it is an orderly series of broad subject bibliographies, the importance of which, for reference purposes, is very obvious.

When the classed list is completed the slugs will be rearranged and printed in alphabetical order to form an author catalogue. The completed catalogue will comprise about ten volumes, five of authors and five of classed order. The special collections not classed in the regular manner will be added in a separate volume.

On account of the enormous expense there can be but one card catalogue, while a copy of this printed catalogue may be located at any point in the library or other buildings on the Campus and consulted at will. Its advantages, aside from its duplication and portability, are many. A page contains on an average sixty eight titles, which may be consulted rapidly and almost at a glance, while to turn over 68 cards in a card catalogue takes very much more time and causes greater eye strain. Each slug forms a title unit. The ability to use these title units in various arrangements by the simple process of sorting makes it possible to provide working bibliographies and special finding lists as aids to study and research. The slugs are pulled out of the main reservoir and when the printing is finished filed back again to await further use, either as a part of the large catalogue or in other special ways. Having the title limited to one bar of 100 letter spaces makes the title units all alike in size and minimizes the danger of misprints and losses of portions of the entry, which is bound to happen if a title is allowed to run over into more than one bar.

A title-a-line linotype slug is a solid strip of metal containing spaces for 100 letters. Within these 100 letter spaces the cataloguer places the name of the author with his initials, a short title for the book, the place and date of imprint and the library call number. Here is a sample slug (shown in two lines instead of one because of our narrow columns):

Strange, T A. Guide to Collectors. Eng furniture, decoration. Lond (1918?) 4595 884

It will be noted from this sample that 14 of the 100 spaces are not needed for actual letters and are, therefore, filled in with dots (that the call number may appear in each bar at the extreme right, thus bringing the call numbers on the various bars in alignment where they are most easily read.

The slug for the regular catalogue is 5½-point type on an 8-point slug, which automatically gives the proper spacing between lines. For subject headings, a 10-point type on a 10-point slug is used, and for straight printing, such as a preface or an introduction, a 10-point type on a 12-point slug. Black face type, where emphasis is desired, may be used, and both black face and light face type may be used on the same slug. Subject headings are made conspicuous by using black face type. To facilitate handling and alphabetizing, each slug is slipped into a small paper jacket, at the top of which is printed the title it contains.

When not in actual use for printing, the slugs are filed away in small wooden galley trays, 12"x6"x¼". At either end of this tray a small strip of wood is tucked 2"x10"x10". About 68 slugs, or titles, are placed in each tray and the whole filed compactly in small pigeonhole shelves.

The machine used for making the slugs is the Mergenthaler Linotype machine, and the printing is done on a Multicolor press.

A Farmer's Loading Station

IT is called variously a bag, a sack, a short sack, a gunny sack, even a poke, providing what part of the United States you happen to be in, but for one loading purpose, at least—the transportation of grain from farm to market—its hitherto universal rule is threatened. Grain sacks got up to twenty-five and thirty cents apiece the past season, they are lower at present. But whatever price they command won't trouble this year those farmers who own a loading station.

The farmer-owned small loading station is one of the newest things in the American grain industry. A typical loading station, recently completed at Shafter, Cal., indicates the general character, as well as the merits, of the idea. This loading station has twelve bin capacity, a total of 72,000 bushels, and was installed by a hundred grain raisers who coöperated.

The bins are of metal and are mouse-proof and weatherproof. Concrete pits are installed close by. Into the pits arriving grain is dumped from wagon or truck, in bulk, and weighed, cleaned, graded and then stored, by elevator. The bins are so arranged and connected that the rapid shifting of grain from one bin to an other or to railroad car is easily effected.

Under the Shafter plan the threshed grain is hauled immediately from field to loading station in bulk. Bags are dispensed with and the quick handling averts rat and squirrel waste at the farm. The grain remains in the loading station until the farmer wishes to sell, or until cars arrive. Wheat, barley, kaffir and gyp corn are the principal grains of this section, but rice and beans will be placed in this storage as needed.

As regards the financial aspects of the plan, the Shafter farmers say they would have saved the entire cost of the station had they had it available for the last crop. This movement toward more efficient handling of grain at source is likely to spread.

The French Suggest a 200-Mile Gun

Super-Range Guns Are Possible, but Costly and Futile

IT was inevitable that the construction and use by the Germans of a super range gun, capable of bombarding Paris from a distance of 75 miles would direct the attention of artillerists to a theoretical investigation of the design, cost and utility of such pieces. The ordnance experts of several nations, including our own, have drawn up tentative designs but, at least in our own case, without any serious purpose of constructing such guns.

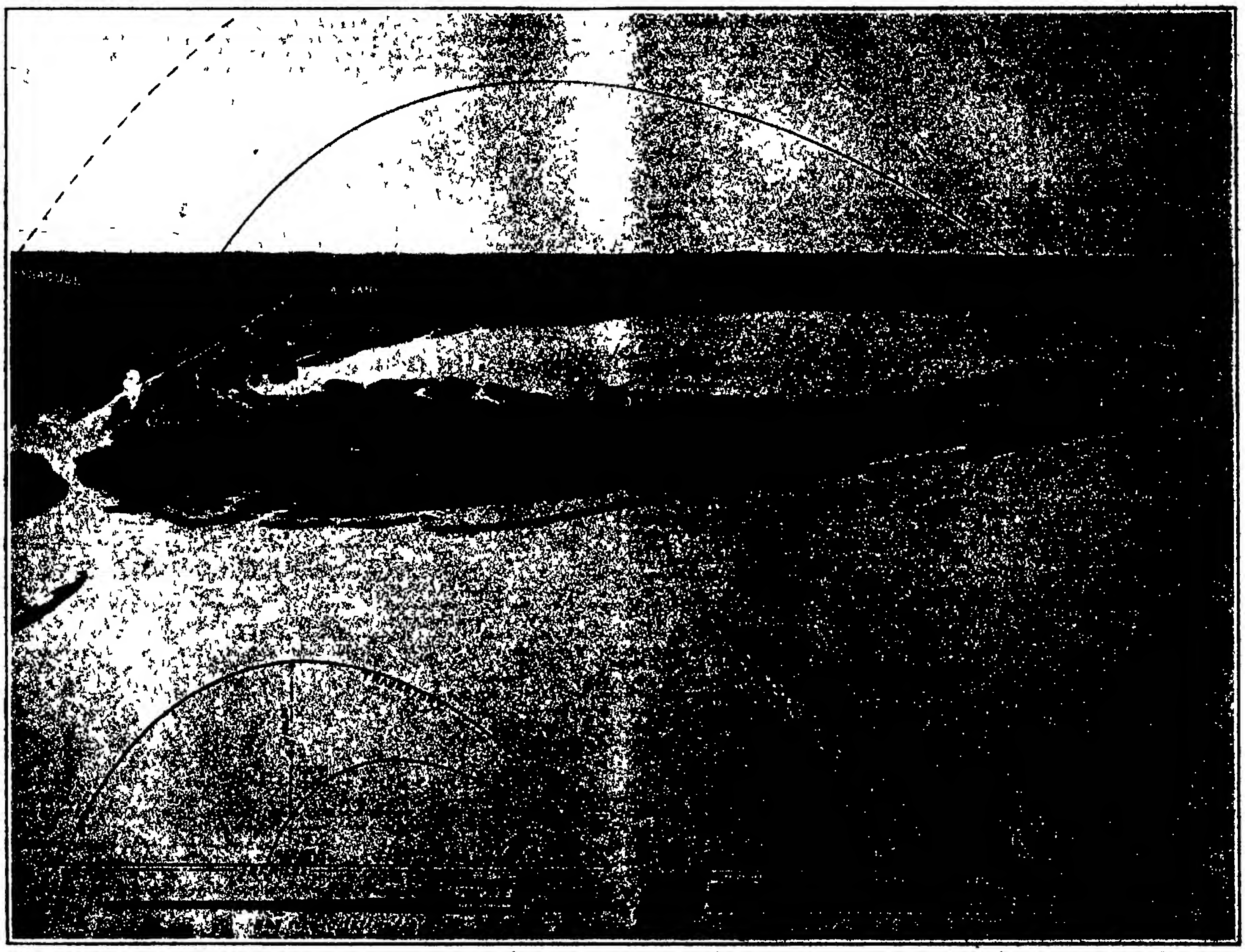
It was more than anything else with a view to proving how costly in time, labor and money is a super-range gun when compared with the damage which it can effect, that the officers of our Army Ordnance designed a gun with a range of over 120 miles. In order to secure accurate ballistic data the design was worked out just as though it were to form the basis of ultimate working drawings, and the results, therefore, are quite accurate as far as they go

In the drawings we show the enormous proportions of this gun, as compared with one of the same caliber but of normal length and weight, together with their trajectories and those of the German gun which shelled Paris, and the once much discussed Brown gun. It should be understood that all but the German gun are of 10-inch caliber.

Super-Range Calls for Enormous Weight and Length of Gun

Regarding the limited usefulness of super-range guns, it is sufficient to state that in order to keep the weights within reason they must necessarily be of limited caliber With the present powders super range can be obtained only with an enormous powder charge and an extremely long gun The reader should bear this in mind when he studies the table comparing a standard 10-inch rifle with one of 121-mile range The length goes up from 42 to 225 feet, the weight of the gun from 88 to 325 tons, the weight of the projectile is less, dropping from 500 to 400 pounds, but to secure the enormous velocity of 8500 foot-seconds, the weight of the powder charge goes up from 200 to 1440 pounds. An impressive evidence of the important part played by velocity as compared with mass in the production of energy in a projectile is shown by the fact that, with a rise of muzzle velocity from 3000 foot-seconds to 8500 foot-seconds, the muzzle energy, although the shell is lighter, increases from 31,000 to 201,500 foot-tons.

Our illustration gives an impressive picture of the meaning of a 121 mile range, for if a gun of this kind were to be built and emplaced at Montauk Point, at the easterly end of Long Island and elevated to between 53 and 55 degrees, its shell would leave the muzzle with a velocity of about a mile and two-thirds per second, would soar to a maximum height of 45 miles and would drop into the center of Manhattan Island after covering an airline distance of 117 miles. A reduction of a few miles to bring it upon the island would be accomplished by a slight reduction either in the powder charge or in the elevation. As a matter of fact, variation in the powder and the impossibility of determining the exact atmospheric conditions throughout the trajectory might well cause a variation of a few miles long or short of the calculated range.



Shortly after the war our Army Ordnance made a study of the dimensions, powder charge, weight of shell, etc., of a gun with a range of over 120 miles. If such a gun were built, it could bombard New York City from Montauk Point. The French are now experimenting with a type of 8-inch gun said to embody new principles of construction, and using a special form of powder, with which in a large gun, they expect to achieve a range of 200 miles. Such a gun could throw a shell from Montauk Point to Syracuse, New York.

A study of super-range guns

Proposed French 200-Mile Gun

In a recent issue of *Army Ordnance*, mention is made of a dispatch to the *Chicago Tribune* from a French correspondent, which gives some particulars of work which is being done by Lieutenant Colonel Mass, of the French Army, in the development of a gun of this type. It seems that the tests of a similar gun, built on the principles of the proposed larger gun, were made at the Belgian Artillery Range at Vivegnis, near Liege, in the presence of several French and Belgian staff officers. The tests were made with a 75-centimeter piece, and they covered a period of six days. The gun is designed on what, according to the dispatch, is called the "turbo"

principle, whatever that may mean. The most intelligible item of information, inasmuch as it suggests the lines along which high velocity are being sought, is the statement that the barrel of the gun will be of "equal thickness from breech to muzzle," and that it can stand a pressure of 21½ tons per square inch. Colonel Maze, according to the item quoted, seems to credit the Germans with having developed a special powder for use in the 75-mile gun "which continues to exert its maximum pressure until the shell leaves the muzzle." The turbo powder apparently is a further development of this type

Of course, anything which would cut down the unwieldy length of long-range guns is desirable, and nothing would do this more effectually than a so-called slow-burning powder whose burning area, and therefore the volume of gas given off, would increase in the ratio of the increase of the velocity of the shell—that is to say, at the rate of the increase of volume back of the shell. At present the powder pressure in a standard 10-inch gun such as the Elswick piece, shown in our table, falls from 18 to 20 tons per square inch at the breech to probably about six or eight tons at the muzzle. In a gun with a constant maximum powder pressure—that is, a pressure equal to the chamber pressure—existing right through to the muzzle it would of course be necessary to design the gun with practically equal thickness of metal throughout its full length.

But What About Erosion?

The powder pressure adopted in this gun is over 21 tons per square inch, which is high Furthermore, since this pressure is to be maintained throughout the travel of the shot down the bore, erosion, which usually is severest at the commencement of the rifling will in this gun extend at full severity throughout the whole length of the gun. Not only will the temperature be excessive but (and this is of equal if not greater importance) the time during which the earlier portion of the bore is exposed to this high temperature will be prolonged. In fact, no element would seem to be wanting to produce erosion in its most exaggerated form Possibly Lieutenant Colonel Maze has secured a special quality of gun steel that is highly resistant to erosion If so, he must be in possession of a quality of gun steel which the maker has been diligently searching for lo! these many years, but without any promise of success.

The Game Not Worth the Candle

But even if the French or any other people should produce a non-erodible gun of 200-mile range, is the game worth the candle? Decidedly, we think not We were told by the Ordance officer who made the calculations for the American theoretical 120-mile gun, that a single one such piece, with its mount, concrete emplacement, loading gear, etc., would cost $2,500,000 Surely, a 200-mile gun, even with the suggested new powder and other improvement, would not cost, with its mount, any less. So what would we have? A two-and a-half million-dollar-investment, capable of dropping, say, a 500-pound shell with 80 to 100 pounds of explosive within it, with no attempt at close accuracy, upon a target 200 miles away On the other hand, for forty or fifty thousand dollars, it is possible to build a bombing plane which can drop a 2000-pound bomb in the same area and with at least 100 times greater accuracy

Could Never Have Sunk the "Ostfriesland"

If a 200-mile gun had been built and set up on the Virginian Coast and given the task of sinking the "Ostfriesland," anchored 200 miles at sea, the chances are 1000 to 1 that it would have failed to hit, much less to sink her Airplane observation of the fall of the shots would have proved of little service. For after the corrections had been radioed in and applied, the slight variation in the quality of successive charges of powder, plus the unascertainable variations in the atmospheric density throughout a trajectory which would rise some 75 miles above the earth, would combine to throw the shell several miles wide of the mark, Only in a perfect vacuum might fairly accurate shooting be done, and even then there would be wide dispersion due to powder variations.

The Power of a Modern Gun and of Thunder

THAT these two subjects are connected in any way is certainly not apparent at first sight. As a matter of fact they are related, and a satisfactory answer to each may be found by following the same line of thought.

The ability to strike decisive blows is the supreme desire of the commander-in-chief of any army, and generally speaking, this can be accomplished only by concerted action on a large scale. If Xerxes could have concentrated the effort of his huge army for a very brief period of time, the battle of Thermopylæ would not have been famous. The capability of delivering such blows, and of doing it repeatedly, is another name for preparedness.

Just as it is proper to estimate the strength of an army in terms of the number of its units, it is natural to describe the power of an army—its ability to deliver decisive blows—in terms of the man power it is able to concentrate The modern gun and the high explosive shall make possible this concentration of man power on a stupendous scale, and while the fact is well recognized, the magnitude of such concentration of power is not appreciated.

For instance, in a modern 14-inch gun a charge of 430 pounds of powder will give a projectile weighing 1560 pounds a muzzle velocity of about 2500 feet per second, and a fair estimate of the time required for the projectile to reach the muzzle is 1/30 of a second When the projectile reaches the muzzle its kinetic energy is

$$\tfrac{1}{2}\,(1560)\,(2500^2) \div (32.16) = 151{,}585{,}820 \text{ foot pounds}$$

This useful energy has been produced in 1/30 of a second, therefore the rate at which the gun works while the projectile is in the bore is

$$30\,(151{,}585{,}820) \div \frac{60}{33{,}000} = 8{,}250{,}736 \text{ horsepower}$$

If it is assumed that one horsepower is equivalent to the power of six men, it is clear that during actual performance the gun does useful work at the same rate as would be required by the concerted effort of an army of forty nine million men. Purely from the standpoint of mathematical mechanics a comparatively small army provided with modern guns is much more powerful than a tremendous army which is not so equipped. By the invention of such engines of destruction as the modern gun and the high explosive shell we have been enabled to wage war, as it were, on margin.

COMPARISON OF A 121-MILE GUN WITH A GUN OF STANDARD RANGE

	Elswick Standard Gun	Theoretical Super-range Gun
Caliber of gun	10 inches	10 inches
Length of gun	42 feet	225 feet
Weight of gun	34 tons	325 tons
Weight of projectile	500 pounds	400 pounds
Weight of powder charge	200 pounds	1440 pounds
Powder chamber pressure	40 000 lbs. per sq in	45 000 lbs. per sq in
Muzzle velocity	3000 foot-seconds	8300 foot-seconds
Muzzle energy	31,000 foot tons	201,500 foot tons
Maximum range	25 miles	121 3 miles
Angle of departure	45 degrees	55 degrees
Angle of fall	50 degrees	50 degrees
Summit of trajectory	7 8 miles	45 miles
Velocity at summit	1550 foot-seconds	2000 foot-seconds
Terminal velocity	1005 foot-seconds	2750 foot-seconds
Time of flight	1 min. 37 secs	4 min 9 secs

Thunder

Any person who has heard the noise produced by the travel of a large projectile overhead or nearby knows that it is very similar to sharp crackling thunder It is assumed for our purpose that the rate at which the air has been disturbed when we hear this type of thunder is of the same magnitude as the rate at which the air is disturbed by a projectile whose passage through the air makes a very similar sound This comparison is interesting because the latter quantity can be calculated without difficulty

Of course the rate at which the air is disturbed by the passage of a projectile depends very largely upon the shape of the projectile and its behavior in the air If it is poorly stream-lined or travels end-over-end, it transfers a comparatively large proportion of its energy to the air, and in such a case its diminution in velocity is very rapid. Many investigations have been made to determine the form of a projectile which would transfer as little of its energy to the air as possible. Probably the most important information on this subject has been obtained as the result of wind tunnel experimentation By this means it has been proved that a projectile may be so stream-lined that the resistance it will offer to the passage of the air is only two seventy-thirds of the resistance that would be offered by a thin disk, equal in area to the greatest cross-section of the stream lined projectile, exposed, head-on to the same current of air

Using a projectile that would cause considerable disturbance, an approximate idea of what happens is given by the example which follows. A square-end projectile weighing 900 pounds is fired with a muzzle velocity of 3000 feet per second and strikes the earth 5 seconds later with a velocity of 2200 feet per second It has been fired at a low angle of elevation because the greatest proportional diminution in velocity occurs when this is done *As only a very small portion of the* energy is used in heating the projectile it may be assumed that the energy lost by the projectile in flight is the energy that has been transferred to the air The violence of the air disturbance is the rate at which this transfer has taken place The kinetic energy lost by this projectile in 5 seconds is

$$\tfrac{1}{2}\,(900)\,(3000^2 - 2200^2) \div (32.16) = 58{,}208{,}900 \text{ foot-pounds}$$

therefore the violence of the air disturbance is

$$(58{,}208{,}900) \div (5\ 550) = 21{,}167 \text{ horsepower}$$

From this it would follow that the *magnitude* of the air disturbance in thunder is 20 000 horsepower

Glycerine from Sugar

ABOUT three years ago it was understood that the Germans had made some progress in the manufacture of glycerine from sugar fermentation The acute shortage of fats necessarily led to an equally acute shortage of glycerine urgently needed in the manufacture of munitions The usual method of obtaining glycerine hitherto has been that of fat splitting or as a by product in soap manufacture The fat is "split" into its two main constituents—glycerine and fatty acids, the latter being used for soap-making In the process of splitting a certain reagent or chemical is used, one of the best known being Twitchell's reagent. Another well known reagent largely used in Germany is *that introduced by Dr W Connstein of the Vereinigte* Chemische Werke Akt-Ges., Charlottenburg Dr Connstein has therefore been instrumental not only in improving the old method of glycerine production, but, in collaboration with his colleague Dr K Lüdecke, he has done a great deal of work in connection with the new method of manufacturing glycerine from sugar

In a recent account of his process and of the progress made in Germany generally Connstein pointed out that, even before the war many users of glycerine and of glycerine products, *e g*, dynamite, had earnestly desired to find some other source of glycerine, owing to its increasing cost due to speculation and also to partial monopoly It is observed incidentally that the trust movement in the English soap industry was tending toward a complete monopoly of the glycerine trade, and that one single English firm controlled at least 14 per cent of the total world production of glycerine One would have thought the percentage was much higher, but in any case the large consumers of glycerine especially in America were becoming alarmed at the upward trend of prices under the alleged monopoly Whether the new process will be perfectly successful and commercially feasible under normal conditions—assuming that these ever return—it should at least serve as a useful check on undue speculation and monopolistic prices

The main technical details of the new process are as follows In the ordinary process of sugar fermentation in a weakly acid or neutral medium the chief fermentation products are alcohol and carbon dioxide (carbonic acid gas) together with small quantities of succinic acid and glycerine as by products. The chief feature of Connstein's new method is that an alkaline medium is used for fermentation instead of a neutral or acid medium sodium sulfite being used By this means the percentage of carbon dioxide evolved is reduced while that of the glycerine is considerably increased It is claimed that, with the use of sodium sulfite the following yields are obtained from one kilo of sugar 300 g alcohol, 50 g acetaldehyde, 230 g glycerine, and 420 g carbon dioxide In carrying out the laboratory tests 10 liters of water, 1 kilo of sugar 100 g yeast, 400 g sodium sulfite and a certain proportion of mineral salts serving as a nutrient for the yeast, were introduced into a 12 liter flask, well shaken up, and kept at a temperature of about 30 deg Cent After a short time the appearance of carbon dioxide bubbles announced the beginning of fermentation After 36 hours the sugar has entirely disappeared (Fehling's reduction test), and the liquid is separated from the yeast—which may be used again—by filtration and the solid portion or filtrate is distilled The alcohol and acetaldehyde are thus distilled over and removed while the liquid residue is treated with calcium chloride and lime to remove the sulfite still remaining It is then further treated with soda to remove excess of lime, again filtered, acidulated, and evaporated In this way a highly saline crude glycerine is obtained which, after removal of the salt, is distilled, yielding a refined product equal in quality, it is claimed, to the best dynamite glycerine hitherto produced.

Tunnelling the Selkirks

How the Pneumatic Placing of Concrete Has Solved a Difficult Problem of the Tunnel Builder

SEVEN years ago the Canadian Pacific Railway essayed an ambitious engineering task when it decided to pierce the rocky backbone of the Selkirk Mountains for a distance of five miles for the purpose of creating a double-track tunnel that would save a climb of 550 feet and shorten the existing route by nearly 4½ miles. So rapidly was the work prosecuted that the new line was opened for traffic in December of 1916 and played an important part in moving men and munitions from coast to coast during the remaining period of the World War

The Rogers Pass Tunnel, as it was originally called, but now known officially as the Connaught Tunnel runs under towering Mount Macdonald in British Columbia Its bearing from east to west is in a southwesterly direction Apart from abridging the journey, the tunnel has made it possible to avoid the upkeep of quite four miles of snowsheds which previously entailed an annual outlay of fully $25,000 a mile

In driving the tunnel the contractors encountered schist, slate, and quartzite. The schist was found relatively easy to drill, even though it proved so tough that more than a single shooting was commonly needed to shatter it On the other hand, the quartzite was hard enough to make drilling rather slow yet the rock broke readily when blasted Owing to the nature of the schist and quartzite it was at first thought that it would be unnecessary to line the bore throughout, and therefore only a few short sections were reinforced by concrete soon after the tunnel was driven

However, not long after the tunnel was in service small rock faults developed at various points. Realizing the enormous weight of the superposed mass, and fearing that the incipient fractures might lead to graver consequences if not arrested, the officials of the Canadian Pacific Railway, in the name of Safety First, wisely decided to have the tunnel walls lined from end to end But the problem was how to achieve this without blocking traffic It was essential that one of the two tracks should be free for the uninterrupted passage of trains bound east and west This requirement, in itself, added measurably to the difficulties of the task Several attempts were made to meet the conditions imposed, but without success, and consequently the undertaking was abandoned for a while

Two years ago the matter was turned over to specialists, and these experts, following much study and investigation, concluded that the tunnel could be lined and one track left clear for traffic by adopting the pneumatic method of putting the concrete in place. The ordinary procedure in doing such a job would be to mix the concrete at the portals and then to bring it into the tunnel in suitable trucks or carriers. Arriving at the working stations the material would be hauled up an incline at the forms where its final disposition would be effected by hand To line a tunnel in this way would, of course, call for the erecting of much scaffolding, and, besides interfering with the movement of trains, might endanger the lives of the men on the job

But the question was not disposed of by merely electing to employ the pneumatic concrete placer The length of the Connaught Tunnel demanded a radical departure in practice In tunnel work, where the bore is not more than half a mile long, it is at times expedient to set the entire plant just outside one portal and to begin the actual lining at the far end When this is done the concrete is delivered through a conveying line laid along the floor or invert, and to this line is coupled hose which is carried up and over the forms for the ultimate distribution of the mixture. As each section of the lining is finished the forms are moved backward, and length after length of the conveying conduit is taken out Thus the point of active operation steadily draws closer to the power and mixing plant.

Experience has revealed that it is neither economical nor efficient to force concrete pneumatically through a pipe for more than half a mile because of the excess amount of compressed air required and owing to the diminished quantity of concrete that will flow from the outlet. Accordingly, the engineers finally chose a portable outfit that can be run upon one track of the tunnel and which is complete, in itself This obviates the use of a long conveying conduit and has made it possible to do the work with a moderate-sized compressor equipment The task involved calls for the lining of 20,000 linear feet of the tunnel, and progress is being made at a very satisfactory pace

Collapsing metal forms in position preparatory to molding the tunnel lining against the outlying rocky bore

As may be readily realized, the engineers have been obliged to employ facilities that would, in addition to leaving one track free, in no wise interfere with signal and other operative circuits, and which would not invite fire hazards. Therefore, the primary source of power is an electric central station situated near Glacier and outside the western portal of the tunnel The generators located there furnish current for the illuminating system needful for the work within the tunnel and for energizing the apparatus which constitute the pneumatic concrete-placing equipment. The smoke conditions, especially after a locomotive has ascended the tunnel gradient, would much more seriously hamper the operatives but for the installation of powerful flood lights. These lamps permit the illumination to be varied quickly to meet the changing state of the atmosphere, and thus materially shorten the enforced intervals of idleness and are so powerful that their beams penetrate the dense clouds of smoke emitted by the passing locomotives.

The self-contained concrete placing outfit is mounted on two flat cars joined together One of these vehicles carries an air compressor, a couple of air reservoirs, water tanks, and a bin for the storage of gravel, and the companion car has a similar gravel bin, water tanks, a compartment for the storage of cement, a concrete-mixing machine, and a Ransome-Canniff pneumatic placer from which the concrete is blown through a suitable flexible pipe or hose to the point desired. Between the two cars there is a power-driven bucket elevator which transfers gravel from one bin to the other The compressor, the mixer, and the elevator are actuated electrically, and the current is fed from the central station through cables which are led for the most part through small parallel tunnels that were cut to facilitate the removal of spoils from the main tunnel at the time of its construction

Now let us see how the concrete is handled and deposited so as to form a coating or lining against the sides and arched roof of the tunnel. First a footing or foundation course of concrete is laid at each side of the tunnel. When this has set a line of temporary rails is laid alongside both footings, and upon these rails roll the wheels which support the arching, steel, collapsible forms which span the tunnel Upon the outer surfaces of these forms are secured, longitudinally, heavy two-inch planks, and at the ends of each form other boards are fastened transversely—thus creating recesses into which the concrete can be poured to model the lining Successively, concrete is deposited on each flank of the form or mold until the side walls have been brought up to the curved sections or haunches. Then follows the completion or keying of the arch. The mold created by a single form has a length of 21 feet.

In order to cast the key section extending along the top of the form from end to end a six-inch hose, connected with the pneumatic placer, is shoved back as far as possible over the form, and the concrete is blown in and the hose gradually withdrawn as the space between the haunches is filled in this fashion. Finally, the mouth of the hose is fastened to a wooden bulkhead, having a suitable opening for the conduit, and the last batch is then forced in to finish the section. An average day's performance consists in blowing one form As a matter of fact, under ordinary conditions, it is feasible by the pneumatic method to place quite 20 yards of concrete per hour, but in the Connaught Tunnel, owing to the dense smoke that must be dissipated after the passage of a train, it has been found practicable to put in position a somewhat smaller amount of concrete hourly However, the work is advanced at a rate and with results that could not be secured by any other procedure.

The twin-car concrete-placing unit, showing the big six-inch hose in position over the boarded form, forcing the concrete into place

For the sake of those interested in details, let it be said that the electrically-driven compressor has a capacity of 1290 cubic feet of air per minute, and the concrete mixer is able to prepare half a yard of material every sixty seconds. From the mixer the concrete is dropped into the pneumatic placer and from there it is discharged into the delivery hose under an air impulse of 80 pounds pressure to the square inch. Only two men are required in the mixer and placer car—one for each apparatus, and a third is in attendance upon the compressor.

When a form is ready to be filled, the two-car unit

is brought into position beneath it, and then the cars are lifted by eight large jacks just high enough to take the weight of the vehicles off their springs. This is done to give the cars a firm foundation and to prevent their rocking when the compressor is operating at capacity This arrangement effectually obviates any troublesome vibration The motor and compressor parts of the cars are housed over to protect the apparatus from the weather and likewise to exclude from them any troublesome dirt and dust due to the prosecution of the work There are in service six collapsible steel forms, and these make available for pouring daily at least one form while the others remain in position during the hardening of the previously cast lining sections. The storage capacity of water, concrete, and gravel on the placer unit is sufficient to effect the blowing of a complete form without leaving the tunnel for recharging. The shifting of the placer outfit, and the handling of derrick and material cars are done by a gasoline locomotive, and the same engine is used to transport the men to and from the job and also to run a lunch car into the tunnel This latter convenience has proved well worth while because of the time saved by feeding the laborers on the spot

The pneumatic placing of concrete renders it feasible not only to meet difficult situations and to dispose of considerable volumes of the material with rapidity, but the equipment is notably effective in reducing labor costs. A few men, after a brief period of training, are able in this way to do much more in a given time than a larger gang relying mainly upon manual effort

work, it was discovered that the stack leaned slightly to the south and east. A deadman was anchored north of the direction in which it was hoped to fell the stack, in the belief that in this way the tendency of the stack to go too far south might be counteracted An attempt to shoot a line over the top of the stack with a gun used for this purpose by the fire department proved a failure—the stack was too high Then a light scaffold was built up on the inside to a height of 100 feet, a hole made through the shell of the stack, and a ¾-inch cable fastened to another anchor on the inside. The cable was then attached to a manila line, that passed through a double and triple block fastened to a deadman Then the line was run for 50 ft at right angles to the drum of a windlass. Thus the windlass and blocks could exert a strain of about 20 tons, yet even with this powerful pull the top of the stack could be drawn over only about one inch

The next move was to drill a belt of 65 holes around the stack on the side in which it was desired to have it fall, leaving one-third of the circumference untouched except for several emergency holes to be used if necessary Drilling these holes was difficult work on account of the many reinforcing rods.

Then began the work of blasting away the concrete The opening on the north side of the stack for the smoke flues was 4 feet wide and 7 feet high A similar opening was blasted out directly opposite this one This left two sections to act as columns and support the weight. Then these piers were loaded, and shot at the same time The stack listed about a foot in the

defects due to flaws in the steel, to segregations or inclusions and to other causes without causing any destruction to the material examined

The instrument consists essentially of the following six elements A solenoid energized by direct current to effect magnetization of the test piece

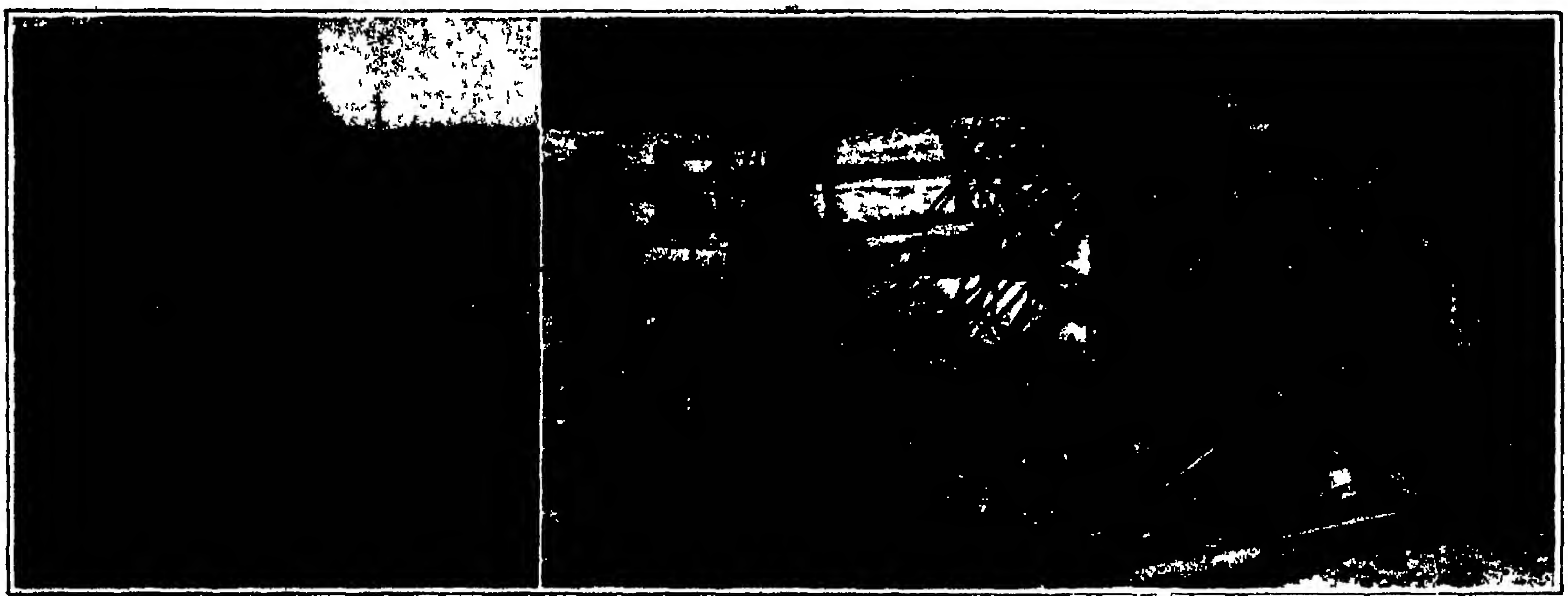
A detector consisting of two test coils having the same number of turns and surrounding the specimen bar whose magnetic variations are to be determined

A motor to impart a relative motion along the length of the test bar to the magnetizing solenoid and detector which are rigidly connected together As the detector occupies different positions along the length of the specimen, it is threaded by an induction depending upon the nature of the specimen If it is not quite uniform the magnetic induction threading one of the coils and the detector is different from the induction threading the other coil, with the result that the e m f generated in one of the coils differs from that in the second test coil Consequently, the small differential electromotive force is impressed upon the detector system every time it passes over the magnetic inhomogeneity

A heavily damped D'Arsonval galvanometer indicating the small electromotive force developed in the detector coils

A recorder which reads the galvanometer and is essentially a photographic film caused to move uniformly across a small slit through whose opening a spot of light is reflected by the galvanometer

A control box containing all necessary electrical switches, rheostats and instruments



Left: Getting the work of undermining the stack under way *Right:* What the base of the stack looked like after the fall

Bringing down a particularly stubborn reinforced concrete stack

A Troublesome Problem in Stack-Wrecking

THE city of Spokane, Washington, had a white elephant on its hands in the form of a giant stack, solidly built of reinforced concrete and rising to a height of 210 feet. This old stack was the remains of an old crematory building which, with the exception of this stack, had been demolished when the new modern crematory was built a short distance to the north This change was brought about through the desire of the Spokane and Inland Empire Railway to widen their yards, and ground was accordingly traded As a result the white elephant was left standing in solitary and threatening grandeur The city wanted to wash its hands entirely of the creature, whereas the railroad company was perfectly willing to hand the towering stack over to anybody wanting a symmetrical toy of goodly proportions. As the days passed by, both the railroad company and the city officials became more and more afraid of the threatening stack If it fell to the south it might destroy several thousand dollars worth of railroad property, if it fell to the north it would almost ruin the new crematory, to say nothing of the possible loss of life that such a disaster might involve. After much heated discussion extending over a period of two years, the courts finally decided that it was the duty of the city to remove the stack Some contracting firms inspected the stack and figured on the work, but not one of them would assume any liability for damage.

When the city engineering department took up the direction of the cable, but failed to fall It was supported only by the reinforcing rods and one-third of the circumference Then the steel bars were cut with an acetylene torch, yet even then the stack did not topple, though about 30 inches out of line. Next the emergency holes on that part of the circumference still untouched were shot, and the stack began to fall slowly in the direction of the cable. The cable was rapidly pulled taut and determined the direction of the fall Finally the portion of concrete left on the back broke, allowing the stack to drop back, and this in turn broke the reinforcing, whereupon the stack fell rapidly The upper portion of the stack collapsed completely, and buried itself deep in the soft ground

It took the crew of four men five days to fell the stack, at a total cost of $275 for labor, staging, lines and powder

The Defectoscope and Elevator Accidents

THE testing of cables in elevators so as to determine any original or progressive defects or flaws therein and thus prevent possible accidents seems to have been realized by recent developments This is due to the rapid progress which has been made in magnetic testing

An instrument called a "Defectoscope" has been perfected by Dr C W. Burrows, of New York, by means of which it is claimed any concealed defects in steel wire or cable strips can be immediately located It is a most interesting device and gives promise of being very useful. Tons of material can be examined for

Magnetic testing being non-destructive of the material has the advantage of being applicable to every piece if necessary but by the proper selection of the characteristics to be measured a single determination—as to whether or not a test piece is of the same magnetic characteristics as an original standard sample—may be made to settle the question.

In addition to the work which has already been done on rails wires rods and cables and upon specimens having circular symmetry such as ball races, balls and milling cutters there is great opportunity for additional developments in the use of this instrument along similar lines Tires gear rings, roller bearings, disk blanks and circular saws are important steel products whose magnetic examination gives great promise Specimens such as drills, reamers taps and other small tools have received but little investigation and yet are of sufficient importance to warrant consideration Small irregular shapes, such as cutlery, graver's tools, small machine tools and chain links, need investigation Large, irregular shapes may present difficulty, but in many cases there is sufficient promise of success to justify investigation At the present time there is no satisfactory method for the examination of crankshafts, steel bottles, and hand saws and a great variety of miscellaneous shapes Other problems for which the magnetic test may yield a satisfactory solution are the degree of perfection of welded joints and study of strains induced in the various elements by the repeated stresses of the service tests.

Recording Locomotive Operation

By Charles N. Winter

AN indicating and recording machine, called a loco-recorder, designed to indicate to the engineer the speed at which the locomotive is travelling and to give a permanent record in the bargain, of speed and direction of motion, whether forward or backward, and to record the time consumed in stops, at stations or elsewhere, is shown in the illustrations This instrument is intended for use in road service and makes it possible to eliminate much of the danger incident to excessive speeds on curves or wherever speed restrictions are necessary A dial pointer indicates the speed to the engineer and the entire story of operation is clearly recorded on a tape that is easily read The duration of stops and slowdowns is clearly shown by placing this record against a keyboard having all of the stations, towers, sidings, or other points on a division at which speed restrictions are necessary, shown in the same proportions as the graduations on the tape Such an instrument is especially valuable at the present time because of the extremely large and heavy locomotives and cars now in use It prevents the unnecessary wear and tear on rolling stock and tracks caused when locomotives that are intended only for slow and heavy service are run at express train speeds.

A portion of this instrument is built on the same lines as a speedometer, centrifugal force actuating a dial pointer which indicates the exact speed at which the locomotive is moving, while two pencils, operating independently, record the time and the speed, on the tape.

The tape is driven by a connection with one of the locomotive driving wheels, moving with it at the rate of a half inch to one mile of locomotive travel

This tape is calibrated horizontally in miles per hour and vertically in miles of track, with heavy lines every five miles.

The movement of the speed pencil across the tape is in direct proportion to the speed of the locomotive and it returns to zero at every stop Each change of speed is instantly indicated on the dial and as the dial and the recording mechanism are interlocked the acceleration and deceleration are recorded on the tape and easily read at the end of the run.

A clock mechanism operates the time pencil, which moves across the tape in 10-minute strokes. This pencil makes an angular line when the locomotive is in motion, the angle depending on the rate of speed When the locomotive stops the pencil makes a straight vertical line on the tape, the length of the line showing the duration of the stop in the ratio of 3-16 inch to one minute of time.

Besides being a safeguard in train operation, the advantage of using such an instrument lies in the fact that a complete record of the operation of several locomotives may be obtained for comparison, providing an accurate basis on which to make any changes that may tend to improve the service. A similar instrument has been designed for use on switching engines. This instrument records the performance of the locomotive on a tape in the same manner as in road service but as excessive speed is not often attained in switching service, the speed indicator has been omitted. An odometer automatically records the mileage, registering every 35 feet It can be set back to zero whenever it is desired to do so The use of such a machine gives a complete record of the operation of a switching engine that could not easily be obtained in any other way and makes it possible to compute the idle and working time of a locomotive in such service.

The True Physiological Nature of Shock

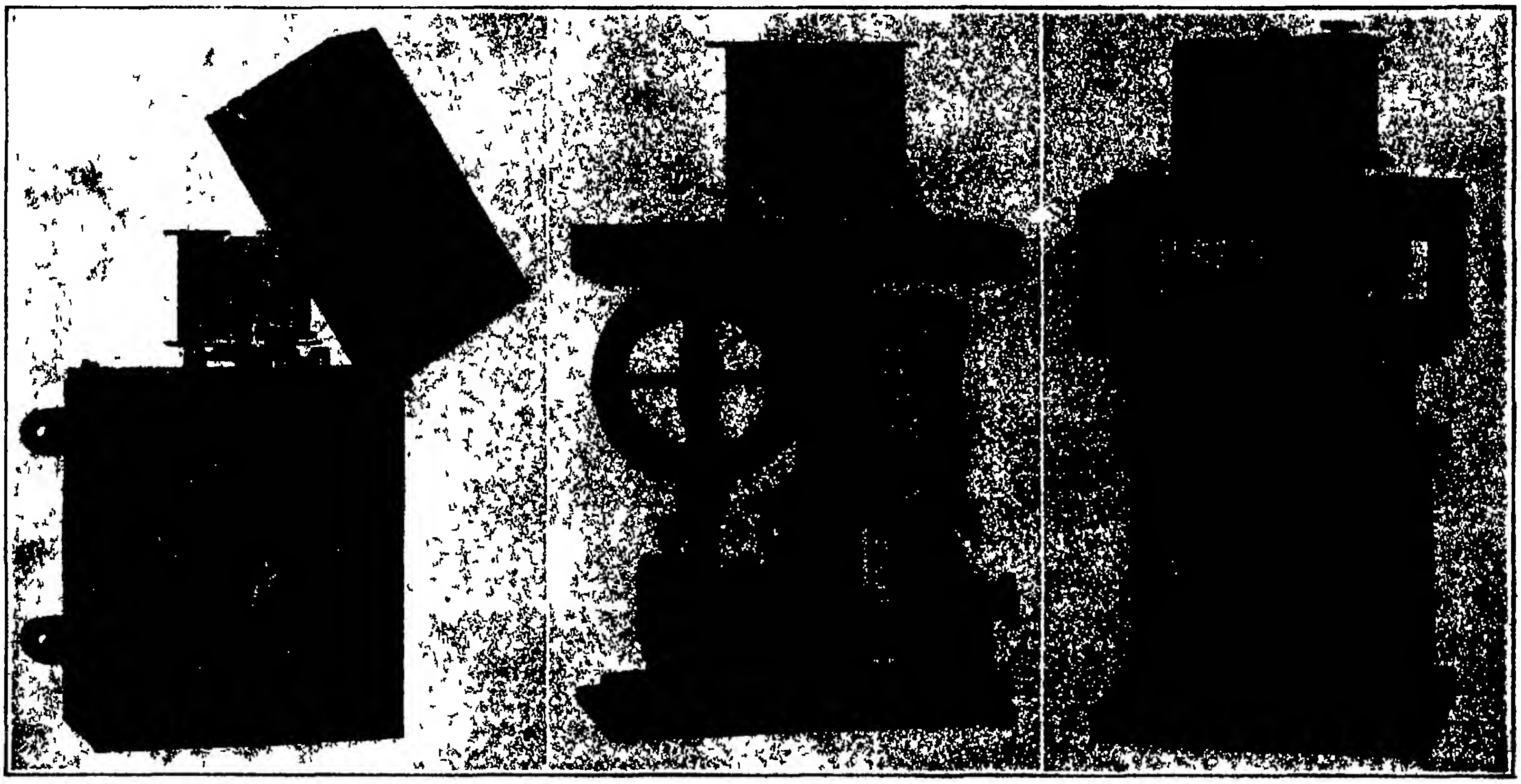
IT has long been supposed that the traumatic shock from which wounded men suffer is a nervous phenomenon. This view has recently been combatted by a French surgeon, Dr E Quénu, who holds that this so-called "shock" is really due to intoxication, *i. e.*, to the absorption by the blood of toxic albumens proceeding from crushed and bruised tissues. This is not to be confused with poisoning produced by infection, As a matter of fact, the shock is produced at a moment when possible infection is practically negligible. Furthermore, shock exists in many cases, when infection is out of the question, because of the fact that there is no external wound Such cases are well known. For example, a man was imprisoned by the falling timbers of a house wrecked by an explosion, his thigh being caught between two beams, but neither wounded nor fractured It was not possible to rescue him until after 24 hours had elapsed During this time he exhibited no signs of shock. Upon being rescued, however, he at once showed the symptoms of shock and shortly died This case is explained, according to Dr Quénu, by the fact that the subcutaneous tissues had been bruised, with a consequent production of poisonous albumens. The latter, however, were prevented from entering the circulation, owing to the compression of the thigh. As soon as this compression was removed the circulation was re-established, the toxic albumens were distributed throughout the body and at once reacted upon the nervous system as a whole to such a degree as to produce the well-known phenomena of shock.

But if shock were of nervous origin, it should make its appearance very early, while, on the contrary, it is often tardy in appearance. This is because a certain lapse of time is required for the toxic albumens to be formed and distributed in the organism; when their distribution is prevented there is no shock. This may be illustrated by two cases. Two wounded men, whose wounds were accompanied by bruises, had tourniquets applied to prevent hemorrhage. One of the wounded men underwent an amputation above the tourniquet, which remained in position; no symptoms of shock appeared. The other man was operated on *below* the tourniquet, which was removed later; in this case shock made its appearance. According to Dr Quénu, this difference of result was entirely natural, since in the first case the toxic albumens were removed before they had time to be distributed in the body, while in the second they were absorbed in the organism and poisoned it

Another interesting thing is that the degree of shock is in no wise proportional to the gravity of the wound. Thus, a man may have his legs carried off by an exploding shell without suffering shock. His wound is quite open and the toxic albumens are absorbed by the bandage. Another man may have a wound which is purely muscular, but of large extent and depth. In this case there will be shock, because the poisonous albumens will accumulate in the bruised tissues instead of being drained away.

The practical conclusion to be drawn from these observations is that the wounds should not only be cleansed as soon as possible, but that all the bruised tissues, which are the sources of toxic albumens, should be cut out. The existence of these toxic albumens or, as they are sometimes termed, toxalbumens is by no means a matter of mere theory The symptoms of shock can be produced by injecting them into an animal which has not been wounded. A surgeon named Dale produced such a result with histamine, and he further observed that wounds accompanied by extensive muscular lesions produced poisons similar in character to histamine.

Another French investigator, M. P Delbet, has demonstrated the toxicity of bruised muscles. His experiments upon animals have shown, moreover, that the toxalbumens of carnivorous animals are more poisonous than those of animals which feed upon vegetable substances, and this observation led him to inquire whether shock was not favored during the war by too large a percentage of meat having place in the regular diet of the troops.



Left: The externals of the instrument used in general service. *Center:* The internal mechanism of this piece of apparatus. *Right:* The recorder for switching locomotives, minus the speedometer feature.

The device that tells the engineer and the division chief all they need to know about the operation of the locomotive

The Truth About the Devil-Fish

Correcting Various Erroneous Views Which Have Been Spread by the Highly Interesting if Inaccurate Fictionists

By William Crowder

WHEN Victor Hugo in 'The Toilers of the Sea,' penned his immortal description of the combat between a man and a 'polyp,' he rendered one of the most fascinating if not strictly credible accounts to be found in romantic literature. Unfortunately Hugo was not a naturalist and his scientific knowledge was somewhat primitive; as a result both his description of the devil-fish and of the man-hunting attributes of his monster have no counterpart in fact. Still imperfect as this description is, it at least had the merit of giving publicity to a class of animals which would probably have remained little known to few other than professed naturalists, for, as it was once truthfully observed, it has done more to acquaint the world at large with the existence of cephalopods than all the learned and careful writings of the men of science.

Since this classic instance of the employment of these creatures as an aid to excite the imagination, other fictionists with more elaboration, but less art, have continued to use this literary device; consequently the devil-fish and its allies have achieved an evil reputation and are generally conceived to be the most fearful and dreadful of invertebrate animals.

Naturalists, however, have a quite different story to tell; from them we learn that these monsters are not as black as they are painted. Their reports though less thrilling are none the less most interesting, and moreover they reveal traits in these creatures which are among the most extraordinary to be found in the lower animals.

The devil-fish—or octopus—and its allies compose a group of animals which in the language of science is termed the *cephalopoda*. The cephalopods are highly organized molluscs—being very close relatives to the clams, snails, slugs, etc.—and are distinguished primarily by their tentacular sucker arms arranged in a radial manner around the mouth. All are carnivorous and subsist chiefly on fishes and crustaceans which they catch with the aid of these members. There is some evidence, however, that certain squids are part, if not wholly, vegetarian in their diet, for several large specimens captured off Catalina Island, California, were found to have their stomachs full of sea weed.

The best known members of this group are the squid, the octopus and the cuttlefish; these three types which are often confused with one another have undoubtedly figured more largely in popular literature than any other. Yet it may be worth while to mention one which has achieved no little fame in the realm of poetry. This is the nautilus, a cephalopod which bears a beautiful shell of pearly iridescence.

The squids range in size from the little sepiolas of an inch long to the giant *Architeuthis*, specimens of the latter having been found which were said to measure nearly fifty feet over the entire length of the body. These are the largest invertebrates known. They are, however, extremely rare, as very few have even been found, and even of these none was in perfect condition due to the attacks of whales and the violence of storms. In this connection it may be observed that sperm whales live almost entirely on cephalopods which they destroy in countless numbers in their excursions through the open sea. The giant squid lives only in the deep sea and has never been seen alive near the waters of the shore.

The common squids of our shores are not unlike the giants in appearance except for size. Rarely do they attain more than a foot and a half in length. They are rovers and often travel in shoals following schools of young fishes or minnows. Often, however, a lone individual will stalk its prey, and as it swims it presents some remarkable color changes. This peculiar property of changing its color, which is also shared by other members of the group, is due to pigment cells covering the entire surface of the body. These cells work somewhat after the principle of the pupil of the human eye. When the animal is colorless a dilation of these minute organs exposes a pigmented area; each chromatophore, as it is called, assuming a pin-point dot of a reddish brown, expands like an enlarging freckle until the edges meet. These changes can be produced almost instantly from white to a deep brown or purple or the reverse, and can be restricted at the will of the squid to different areas of the body, giving the animal a mottled appearance which enables it to simulate the pebbly bottom with astonishing realism.

Perhaps few circumstances are more startling than one's first sight of the squid lying on the bottom after it has changed to a deep brown, contrasting strongly

1. The squid, photograph taken in a tidal pool. 2. Suckers on the tentacles of a squid. 3. The octopus, which is doubtless the devil-fish of tradition. 4. A cuttlefish swimming. 5. An artist's conception of the nature and capacity of the devil-fish (by Doré), now realized to be absurd. 6. Baby squid, greatly enlarged.

The three best-known members of the devil-fish tribe, as they are and as they are not

against the substratum when suddenly it almost dissolves from view by turning to a ghostly white and slinks away like a specter of its former self

In addition to this method of making themselves invisible, these animals utilize an organ which produces an effect similar to the smoke screen employed by naval vessels This organ is the ink bag When an individual is irritated or pursued it ejects a black substance which clouds the water and disconcerts or confuses its enemy

The harvester that carries the thresher with it about the fields

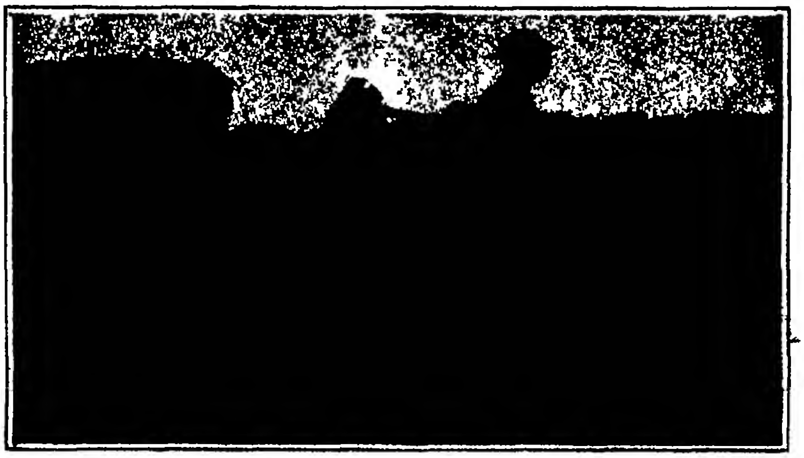
The mode of progression used by the squid is no less curious than the features just described Its body may roughly be compared to a hydraulic pump wherein the water enters at one aperture and is expelled at another It is the force of the water directed through the vent, or siphon, located just below the head at the base of the tentacles, that propels the animal This force is produced by contractions of the mantle which is the loose sac-like body that envelops the vital organs of the creature Usually the squid swims backward, that is, tail foremost, but it can swim forward with equal facility simply by turning its flexible siphon in the opposite direction

Strangely enough the octopi are the cephalopods which have always been featured in the exploits of journalistic tales yet these individuals neither have the aggressiveness nor do they attain the huge proportions of some of the squids. It has been extremely infrequent that an octopus has been found with tentacles measuring over ten feet long And even when those large specimens were caught they showed no disposition to fight but invariably made a desperate struggle for liberty Although these animals are possessed with great strength and are armed with a powerful weapon in the form of a sharp parrot like beak, they appear to be unconscious of their power and seem never to attempt using it in their defense

The octopus is one of the most timid of animals and will retreat when a human being comes near it. It can be observed in its natural habitat, however, if one is cautious in approaching it, for, in common with most wild creatures, they recognize as inimical only moving objects. The difference between an octopus and a squid may be stated tersely by saying that the former has eight long tentacles and a short body, while the latter has ten short tentacles and a long body It is partly due to these relatively long arms, however, that the octopus gets its unsavory reputation, for without a doubt these long writhing organs make it the most hideous and gruesome of all creatures. It lies secreted in rocky crevises, awaiting its unwary prey When some unlucky fish or crustacean passes near, the lurking monster throws out its tentacles with astonishing rapidity, and when once the suckers, which line the inner surface of the arms, have touched the victim, there is no escape It is carried to the mouth where it is despatched at once by a bite through the back.

The hard and stony stare of cephalopods doubtless has also much to do with the general impression of horror which attaches to one's sight of these creatures. The visual organs of no other animal have the ghoulish expression that is in the eyes of the devil fish This weirdness is further accentuated by the writhing and tortuous movement of the animal's body as it crawls from place to place, for, unlike the squid, it seldom swims about in its travels. It can swim very well, however when the occasion requires, and, when so doing, it employs its siphon together with rythmic contractions of the web-like membrane which connects the bases of the tentacles.

The female octopus is an extremely devoted parent. She usually selects for her nest a recess in the rocks below the tide level, and guards the eggs with all the jealousy of a mother hen When first laid, the eggs are small oval bodies, somewhat resembling translucent grains of rice growing around a common stalk Each egg is separately attached to the stalk by a short peduncle, the whole being not unlike a bunch of tiny white grapes. The average number of eggs in the brood of a full-grown female is fifty thousand The parent aerates them occasionally by manipulating the clusters with her tentacles and frequently directing a current of water upon them with her siphon Seldom does she leave the nest, and then only for a short period when it becomes necessary to search for food The brooding period lasts about seven weeks, at that time the young hatch soon leave the natal precincts to begin an independent life free from maternal care The babies are quite different in appearance from the adults, having undeveloped arms which decorate the head like a raked crown



The stripping machine that harvests the seed and leaves the grass

The cuttle-fish is a cephalopod which in appearance has more of the attributes of the squid than of the octopus. That is to say, it has a proportionately long, but somewhat flattened, body and ten arms. Eight of these arms are relatively short, it has, however, two long slender tentacles which are devoid of suckers except on the club-shaped region at the ends. These organs are generally kept retracted close to the head and are brought into play only when capturing food These animals are abundant in tropical waters. They are harmless and inoffensive creatures and never attain the sizes of the larger devil-fishes. It is from this animal that the India ink and sepia of commerce is obtained. The "cuttle-bone," which is a familiar object in the cages of canary birds, also comes from this individual. This is not a bone but is the internal shell secreted by the animal.

Now it cannot be gainsaid that the cephalopods above described are hideous and forbidding in aspect; are, in certain instances, of unusual size, and are ruthless in the capturing of their natural prey But the writer submits that there is nothing in these indictments which should indicate that they have a predilection for attacking humans. In his own contact with these animals, in the waters of three oceans where they abound, he has gathered no evidence, either by actual observation or authentic testimony, that devil-fishes, regardless of size, have shown anything but fear at the sight of man.

So generally established among a misinformed public is the dread of devil-fishes and their allies that even the most venturesome will shrink from bathing in waters which are known to be frequented by them Indeed, this prejudice is even maintained in more restricted environments, for in an actual test recently made in a marine laboratory where an octopus with arms a foot long was confined, out of scores of visitors who passed the tank and were asked to touch the animal, less than two per cent did so, although in each case the request was made after earnest assurance was given that the devil-fish was harmless and would merely squeeze the hand.

Harvesting and Threshing in a Single Operation

AMONG interesting farm apparatus put on the market recently, a high place must be awarded to the combined harvester and thresher illustrated at the top of this page By an arrangement for making the tractor a part of the harvester-thresher, yet permitting its removal for other work, the auxiliary motor and pulling hitch are dispensed with at a heavy saving. The outfit cuts a swath 16½ feet wide, at a maximum speed of 8½ miles per hour, giving it a capacity of seven acres an hour A feature is an arrangement of the threshing cylinder and blast tube which makes it possible to blow off a high percentage of the chaff before the straw and grain pass to the separator, so that the work of the latter unit is greatly lightened and its weight and cost lessened correspondingly The outfit is claimed to take the place of all farm machinery used in wheat raising, with the obvious exception of the tillage tools.

The manufacturers conservatively estimate that with this device a man and boy can raise and market 600 acres of wheat, which means that a great saving in labor is effected.

Harvesting Without Reaping

CARPET grass is the best pasture grass grown in the coastal plain region of the Atlantic coast and Gulf states. Heretofore it has been extremely difficult to harvest the annual seed crop and hence the amount of available seed for sowing purposes on the market has been very limited and the price has ranged from 75 cents to $1 a pound. The stripping machine shown in the accompanying illustration is an efficient and newly designed implement for saving carpet grass seed. By means of mechanical fingers connected with the revolving cylinder at the rear of the machine, the seed is stripped from the plants in the field and elevated by conveyors to the front of the harvester where it is deposited in sacks. The existent high prices and the keen demand for the seed make it profitable for every farmer who grows much carpet grass to own and use one of these modern harvesters.

Another type of machine which strips the seed from the standing stalks

Model, costing $5,000, of a complete ore-concentrating plant, which contributes to the success of college work in this line

The Miner's Dump-Heap Goes to Work

How Values Are Being Recovered from Ores That Were Once Discarded

By M. A Henry

THE American mining industry is rapidly approaching an economic crisis, if, indeed, it does not already face one. In this country there has been no exception to the general rule that the richest ores are first used. The problem now is to produce metals from the remaining ores, constantly growing lower in grade, at a profit in competition with ores from richer but distant fields.

Obviously there is a vanishing point at which mounting cost of production meets haulage costs. Here profit to the local producer vanishes. There is another important element in the situation the greatly expanded needs of American industry. A few years ago it was a very simple matter to supply the moderate requirements of industry at a good profit from a few rich ore deposits. But the amount of raw material used in American industries has increased at such an astounding rate that now more than 75,000,000 tons of iron alone are consumed each year, and many more millions of tons of copper, nickel, zinc, lead and other metals.

Mining is one of the oldest of the industries, but it has made very slow progress down through the ages. It is rather astonishing to find that many of the mining methods and machines used as "standard" today have been used for hundreds of years. But the economic situation as regards mining has developed so far in this country that already it is no longer possible to produce metals at a profit using the methods of twenty years ago.

The mining industry is thoroughly awake to the crisis and is meeting it—successfully. How it is being done ought to be a revelation to the leaders of every other industry.

Two broad lines of action are being followed. It is recognized that the essential needs are, first of all, highly trained men to meet and overcome the individual technical problems; and second, better types of machines. No two ore deposits are alike and therefore no two mining problems are alike. This complicates matters: the mining and extraction of ores cannot be expedited by any of the quantity production methods which have been developed in, say, the automobile industry. The great universities of the country have been appealed to and cooperation between the industries and the mining schools has been carried out to a rather remarkable extent.

There are three essential steps in the process of mining, first, the actual digging of the ore, second, concentration to remove much of the useless material, and third, smelting to obtain the metal. No great improvement in digging methods has been found in centuries, although of course modern machinery eliminates some of the old-time labor. The third process, smelting, has neither been basically changed nor greatly improved.

It is the second process, that of concentrating, or "dressing" the ore which offers the widest field for investigation and invention. In recent years very great progress has been made and indications are that even larger results are in sight. It is on this battlefield that the American mining industry will fight its decisive engagement.

Most of the common metals occur in the earth in chemical combination with sulfur and are known as sulfides. Sulfides are usually associated with various worthless minerals, as quartz and other silicates, limestone, etc. Before the sulfides can be economically treated to obtain the metals as large an amount of the waste or "gangue" as possible must be removed, without at the same time losing too much of the sulfides. This is usually accomplished by mechanical treatment and the result is a concentrate which may contain as little as 35 per cent or as much as 98 per cent of the total metallic content of the ore and more or less worthless material, according to the character of the ore and the efficiency of the process.

The oldest and still the most widely used process is some form of gravity concentration, based on the fact that the particles of ground ore containing metal are heavier than the gangue. Almost everyone is familiar with the "panning" method used by prospectors and the early gold miners. This is the simplest form of gravity concentration. A quantity of ore is placed in a pan of water and agitated. The metal sinks to the bottom and the useless material can be scraped off the top.

There are many methods of doing this mechanically, the most common being a flat and slightly inclined table, over which the ground ore is carried by a sheet of flowing water. The surface of the table is corrugated and the heavier valuable particles collect in these "riffles" and are carried by a shaking motion of the table to one end and are flushed off into a receptacle.

Gravity concentration is an effective and economical method of concentrating ground ores when the particles are larger than 0.01 inch in diameter. When, however, the particles are smaller than this, and especially in the case of very finely ground particles which are designated in concentration practise as "slimes," gravity concentration falls down and the "flotation process" is used. This is the newest revolutionary development in mining and has been given much attention recently. In many of its ramifications the process is not yet thoroughly understood and it offers a profitable field for research. It operates essentially as follows:

The finely pulverized ore is mixed with water in the proportion of three of ore to five parts of water by weight and there is added thereto a small quantity of oil and, under certain conditions, some inorganic chemical compound such as sulfuric acid or an alkali. A gas (air) is then introduced into the mixture, usually either by agitation or through a porous bottom in the containing vessel. As the result of either of these methods of treatment, although by a chain of totally different phenomena, a froth is formed at the surface of the mixture carrying a large proportion of the valuable mineral. This froth is removed by skimming or overflow, broken down, and the mineral collected. As much as 98 per cent of the total mineral content of the ore may be collected in this manner.

The theory of the process is not yet clear, but it has been shown that the introduction of the gas causes the formation of bubbles with a skin of oil and that by some curious force of attraction the particles of mineral cling to the bubbles and rise with them while the gangue is not affected and settles to the bottom.

Aside from the development of the flotation process, mining engineers, however, have devoted their energies principally in recent years to improving existing machines and devising means for handling larger and larger quantities of ore to obtain a proportionately smaller quantity of metal. One engineer discovered, for instance, that by a slightly different arrangement of the "riffles" on the shifting table described heretofore he could increase the capacity several times. The result has been a great saving in labor cost to the large plant. It places the small plant, where only one or two machines are needed, at a disadvantage because one skilled attendant can care for a large number of these machines and the large plant is able to distribute the expense over a larger tonnage. In the very large ore dressing plants there is little or no handling of the ore by hand, while the small plant cannot afford this expensive equipment for its small batches of ore. In slack times the large plant can cut down overhead by operating part of the plant at capacity, whereas the small plant must carry the same overhead for small production as for capacity runs. Another very important consideration, often overlooked, is the fact that the large plant, because of its proportionately smaller labor cost can afford more highly trained men who are able to devise many economies.

The result of all this has been a welding of the companies engaged in mining into larger units, and this process of amalgamation, we may fairly assume, has not reached its limit. The cost of a modern concentration plant may run into millions, and the small concern which cannot afford the most modern equipment is likely soon to find itself forced by economic pressure into combination with other concerns.

But in a final analysis the problems of machinery and plant are secondary to the problem of obtaining highly trained men especially executives. There has developed in the mining industry an insistent demand that practical experience shall be grounded in academic training. To this end the mining companies themselves have begun to cooperate with the universities in the training of men.

One of the newest and best examples of the effect of this policy is found at Columbia University. The ore-dressing laboratories there are just now undergoing an entire building, largely from funds provided by mining companies and individuals interested in the industry. Thoroughly modern machinery is being installed and much of this has been given outright or loaned indefinitely by the makers.

The installation of the machinery is being made on a newly devised "unit plan," by which it is possible to make a large variety of combinations of machines with only a few hours' labor for each change. This laboratory plant is much more flexible and therefore more useful than the old style laboratory in which a single complete ore-dressing plant of approved type was installed.

For each full-size machine there is a working laboratory model, which not only serves to demonstrate the principle involved, but is effective in treating batches of a pound or two of ore. Because of the limited space the handling of ore for the large machines is mostly hand work, and as tons of ore must be handled at each run, the models serve the daily classes and the large machines are operated only at intervals.

Since no two problems in ore dressing are alike, train

ing usually takes the line of a thorough grounding in fundamental principles, with each lesson pointed, where possible, by an experiment with a typical piece of mill apparatus. The man who plans to be a specialist receives more intensive training

"His calls in later work," explains Arthur F Taggart professor of ore dressing at Columbia, "will come only because others have failed in the solution of some particular problem, which usually means that it is new and difficult Hence his training must teach methods of attack and aid the development of the student's imagination, initiative and analytical ability For such a student research into some difficult and slightly explored field is the best of training"

A very comprehensive plan for cooperation between the Columbia School of Mines and the industry has been worked out The scheme most favored is the foundation by an interested concern of an industrial fellowship, either temporary or perpetual A student desirous of taking advantage of this opportunity is chosen by consent between the company and the instructor The student is preferably a candidate for a degree, and the subject of his thesis is chosen by the company, again with the approval of the instructor Between a half and a third of the student's time is spent on the special subject assigned and the remainder on collateral subjects designed to broaden his technical education The usual understanding in such a case is that the student shall enter the employ of the company upon graduation The student, for his part, binds himself not to demand, because of his special training, more salary for the first year than is paid other men of equal training along general lines. At the conclusion of the first year both parties are free to conclude any desirable arrangement.

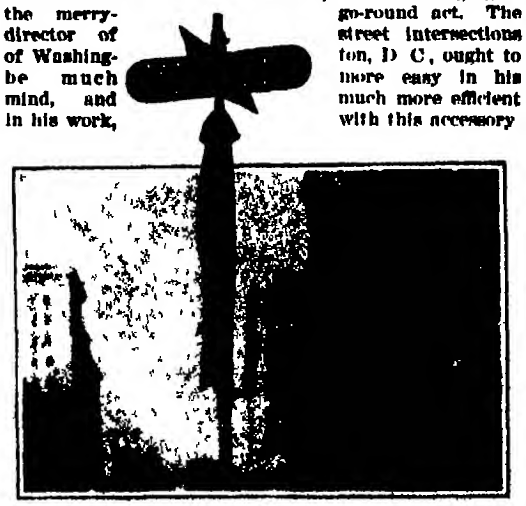
Another plan of less permanent character is one whereby the company may hire one of the students to work on a specified problem, under the guidance of the instructor When the instructor acts in a consulting capacity, in this case, he also is compensated In all cooperative investigations involving the work of a student, it is insisted that the results be available for publication

While the Columbia ore-dressing laboratory is now one of the largest and best equipped in the country, there are several others of possibly equal importance, notably the laboratory of the Massachusetts Institute of Technology The ore-dressing laboratories here are arranged in a manner similar to those at Columbia and this institution has been a pioneer in the matter of industrial cooperation, although the plan devised is radically different from that at Columbia. Here the industrial concern signs a contract form of agreement, submits its problems and pays fees for the work done on them. A recent report indicates the plan has been very successful in the past year

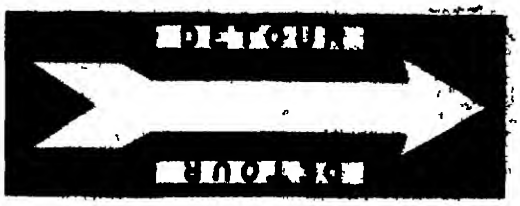
The important result is not to the school, however, for this is only the means to an end The real results are first of all in enlarged opportunity to the student and finally a solution of a very difficult problem for the mining industry The significant thing is that the industry is placing its faith in science for guidance through the difficult years ahead

Mirror for the Motor Cop

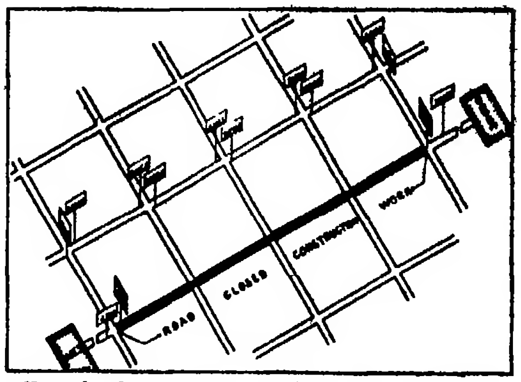
FOOLHARDY indeed the motorist who ventures into our busy streets without the security of a mirror to protect him against reckless driving from behind And now the traffic officer is supplied with similar protection, which serves equally to inform him of the state of traffic behind him without the necessity for his indulging in the merry-go-round act. The director of street intersections of Washington, D C, ought to be much more easy in his mind, and much more efficient in his work, with this accessory



The officer as well as the motorist sometimes needs eyes in the back of his head



Iowa's universal standardized detour sign; the destination goes in the arrow in big letters



How the detour signs are planted so as to leave no room for doubt whether to turn or to bear straight

Marking the Detours

A STANDARD type of detour sign has been adopted by the Iowa State Highway Commission It is the duty of every engineer in charge of construction or maintenance work which seriously impedes or obstructs traffic to see that a well maintained detour route around the obstruction is provided as well as to erect signs to guide and protect the users of that highway while on the detour The signs are erected at such points that require no turning back and at turns and cross roads wherever there is any question of the proper direction to be taken to pass safely around the obstruction without getting further out of the way than necessary

The sign is in the form of a yellow arrow upon a black background Above and below the arrow is the word "detour," so the sign may be used for directing travelers either direction by simply painting out with black paint the lower word. A stencil is used to paint in the arrow the name of the place the traveler is being directed to. In the case of the marked tourist roads, there is space on the arrow for the route marking in colors. In size the sign is 10 by 28 inches, and is printed on tough paper. When displayed it is nailed to a board The counties buy the signs at cost from the Commission and plus the expense of stencilling and place each sign costs about seven cents.

Ohio is another State that has largely abandoned the haphazard way of posting detours formerly in vogue: Its standardized sign is in all essentials the same thing as the Iowa product that we illustrate. It must be confessed, however, that Iowa has been more successful in placing the signs so that a minimum of ambiguity results. In Ohio an effort is often made to set the board at an angle to make it more readily spotted from an approaching car, but the result is more often to create doubt as to whether to bear [illegible] or to turn. Iowa, on the other hand, has a [illegible] of locating the signs, as well as a standard sign; and little may make it clear how this works. Other States approximate to this scheme, but largely, it appears, through accident; in Iowa it is prescribed and understood procedure, to the tourist's great comfort. Ohio, on the other hand, goes Iowa one better in the matter of economy. She does not paint out the lower word "detour," but leaves it in, since its presence leads to no slightest confusion. And she does not stencil in the destination, but pastes in a big paper label bearing the word. The sign may then be moved from detour to detour until it is naturally worn out.

It is gratifying to the motorist to note the general improvement in the posting of detours. Five years ago nobody ever expected to have official guidance out of a detour Today we are indignant if we do not get it; and in addition to the two States here named, and to Wisconsin, whose efforts have been described in a previous article, New Jersey and Pennsylvania may be placed on the roll of honor New Jersey is even issuing a monthly bulletin, which the State Commissioner of Highways will mail to any address, giving full information as to roads closed and detours in effect for the month. New Jersey, incidentally, is doing a lot of work on her highways, without much advertising, and by the opening of the 1922 motoring season, assuming no undue amount of winter damage, she will rank high among the touring States. That this State is one of the most scenic of them all is a fact not as well known as it ought to be, and its attractions are within easy reach of millions of residents of New York, Philadelphia and even Baltimore, Washington and Boston.

Portable Bumpers for the Garage

GARAGE necessity often calls for the presence of a bumper, but the necessity is a difficult one to meet, because it is such a shifting one. Today the bumper is needed here, tomorrow there, next day a bumper in either of these places would be a terrible nuisance, but one is badly wanted at a point where it would have been distinctly out of place before. The portable concrete bumpers which we illustrate herewith are not too heavy to be shifted about with these shifting necessities; yet they are bulky enough to serve admirably the purpose for which they are designed It will be noted that they have each two eyes, to which ropes or chains are attached for the purpose of dragging them from point to point as required.

The garage bumper that is always in the right place

Keeping the Hands Indoors While Motorcycling

FROZEN hands and frost-bitten fingers are seldom so much the product of mere low temperatures as of biting winds. The old-fashioned cab-driver and the chauffeur of today will join voices in testimony to the fact that it is the driving that calls for huge gloves, not the standing still. In recognition of this, one of Washington's motorcycle officers, a man who drives so skillfully that he is called upon to escort distinguished guests about the city and in this employment to drive in all weathers with a continuity seldom approached by the ordinary motorized policeman, has invented a little device to keep the biting breezes off his hands. This consists of nothing more complicated than two leather cones attached to his handlebars in such a way that he drives with his hands inside them. The cone turns off the wind and the ordinary gauntlet is given plenty of protection against anything that Jack Frost may produce in the way of temperature.

Protecting the [illegible]

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Light in Water

TO emphasize the desirability of properly supporting fundamental research *Engineering Foundation* has been distributing "Research Narratives." A recent one on "Light in Water" by L. N. Scott is quoted below

"It is natural to suppose that light penetrates clear water as it does glass. The Prince of Monaco, one of the greatest students of marine life, has shown, however, that there are myriads of animalcules in sea-water and that they cause almost total reflection of a beam of light projected into the water. Therefore, water is not like glass in its transmission of light.

"In connection with submarine detection studies, Mr. Elmer A. Sperry, member of the Naval Consulting Board, made some elaborate experiments on projecting light through water, from which instructive results were obtained. An electric light was used having a sixty-million-candle-power beam, which could be seen through air for 62 miles (150 amperes, 75 volts, condensed and directed by a 36-inch projector)

"This light was placed in the bottom of a steel well resembling a boiler 25 feet long, with an opening in its side near the bottom 40 inches in diameter, in which a plate-glass window one inch thick was sealed. There were several tons of lead in the bottom of the well so that it would sink vertically to any desired depth. It was hung by a bale from a crane on a large barge

"The light was first tested in the muddy waters of the New York Navy Yard, at a depth of 10 or 15 feet below the surface. There was a total reflection of light, but this was attributed at that time to the great muddiness of the water. A luminescent sphere approximately 80 feet in diameter surrounded the window. This luminescence was wonderfully brilliant and acted like a fog to obscure vision. Brilliancy of luminescence seemed to be about the same at all points of the sphere, even exactly back of the well in the rear of the window through which the light was projected

"Experiments were then made in clear ocean water near the easterly end of Long Island. Here also it was found that the beam of light could not be projected through the water as had been hoped, and that a globe of luminescence was produced as in the experiments in the New York Navy Yard. The globe of luminescence was visible through this comparatively clear water for possibly a quarter of a mile, and it could be used for the purpose of silhouetting mines, anchors, cables and other objects of this nature, against its white background with very great distinctness, up to this distance of a quarter of a mile

"The results of these interesting experiments with so powerful a light are a real contribution to our knowledge of the art of projecting light through water. They indicate the impracticability, in most situations, of projecting light to any great depth into water in such a way as to be an aid to divers employed on ordinary under-water operations, or for other purposes."

Leather Nomenclature

THE terms used in defining the various leathers are not only little understood by the average user of leather but by the leather chemist as well, and the compilation of data given by Yocum and Faust in the May number of the *Journal of the American Leather Chemists' Association* will therefore be found helpful and valuable. There are eight designations for various types of sole leather, eleven for the cuts of sole leather, twelve for leathers used in automobile, carriage and upholstery work, five under belting, eight under harness and saddlery and similar numbers under such other headings as light leather of goat, calf, and sheep. Most of us purchase leathers under the designations given to finishes, and the following are taken at random from the definitions given under the heading of grain finishes

"Box Calf—Boarded in four directions shape of squares, so as to give heavy grain.

"Glazed Kid—Goatskins finished with high face by jack.

"Glove Grain—Black dull side upper leather, lightly boarded.

"Gun Metal—Smooth, dull black finish.

"Levant Grain—Usually bark tanned, carefully split, buffed, lightly embossed and grain well boarded.

"Patent—Varnish coat, either linseed or 'dope' (pyroxyline), several layers applied and dried by heat, process called Japanning. Used on bark tanned leather for shoe trade.

"Russia Leather—Gambier tanned calf, very fine grain.

"Spanish Leather—Upholstery leather, whole hide grains or buffs bark tanned and finished dark yellow with irregular black figurations.

"Velour—Glazed, smooth-finished calf

"Ooze—Run on emery wheel to give nappy surface

"Suede—Surfaces made nappy by putting on emery wheel, similar to Ooze"

Malt Extract in Bleaching and Dyeing

THE above is the title of an interesting article in the May issue of the *Color Trade Journal*, and the following uses to which concentrated malt extract has been put in the textile and allied trades are quoted

"(1) Stripping was the original purpose to which concentrated malt was applied. A good malt extract is completely soluble in lukewarm water, and is immediately ready for use. The solvent action is rapid and has no harmful effect on the fiber. The malt has no stripping action on fast dyes.

"(2) The preparation of sizes and mixings forming a starch paste penetrates evenly and does not dust, harden or contract. The excellent series of articles on standard finishes for cotton goods which appeared in *The Dyer* a few years back seem to point out that concentrated malt had become an indispensable ingredient in almost all finishing mixings.

"(3) In the preparation of printing pastes the same advantage of easy penetration of the printing color is obtained. It gives a smooth, even paste and the thickening is readily removed on steaming

"(4) Softening light leathers before dyeing.

"(5) Removing starch from old rags in the paper-mill or for the preparation of gun-cotton.

"(6) Preparing coating mixings for paper. The calender gives the best gloss where malt extract is used

"(7) Clearing dressing from linen previous to adding the 'dope' for aeroplane wings.

"(8) Dextrinizing starch for linen dressing in the laundry, or as 'new work.'

"This list does not pretend to be exhaustive. As the trade progresses, malt extract will go hand in hand with starch in all its multifarious uses."

The Bearing of a Synthetic Dye Industry Upon Our National Welfare

IN the April number of the *Franklin Institute*, an interesting address upon this subject is given and is recommended to those who desire to be informed upon this very important question. What the loss of the industry would mean to the country is set forth under ten headings which we give here

"1. Thousands of unskilled laborers thrown out of employment.

"2. Large numbers of specially trained technical experts forced to seek other means of livelihood, and the economic loss involved in scrapping the experience gained in the dye industry

"3. Abandonment by the manufacturers of all plans for development and expansion, and the closing of plants now in operation.

"4. Fewer students for the courses in chemistry at our educational institutions.

"5. Termination or reduction research work, both in the laboratories of the industry and in cooperative investigations with educational institutions, with all that this implies in retardation of the development of our science at a time when the world is looking to us to take the leadership.

"6. Inability of teachers of applied organic chemistry to give their students up-to-date information in the field of synthetic dyes, through loss of personal contact with the manufacturer, and an inevitable resulting dependence upon the ancient history of the average text book of industrial chemistry

"7. Subjugation of our great textile industry, and of other industries using dyes or dye intermediates, by foreign manufacturers, and in the event of our being cut off from such supplies by another war, once again to be face to face with a famine, not only in the dyes needed for our flags, uniforms, and other articles, and the bacteriological stains for the diagnosis of disease, but in many indispensable drugs and in compounds of serious concern to the manufacturers of photographic chemicals, food preservatives, explosives, toxic gases and other war munitions, paints, inks, perfumes and flavoring principles, artificial resins, plastics, tannics, and accelerators for rubber vulcanization. The distilling of coal tar and the recovery of by-products from the coking of coal will also suffer from the loss of this market for their products.

"8. Should we be one of the belligerents, there will be but few dye plants available for conversion to munition manufacturing (be it explosives, toxic gases, smokes, incendiaries, or what not), and no reserve of trained men to take charge of such operations. It is trite, but true that modern military power is dependent upon industrial organization and efficiency

"9. Domination of our trade in dyes and dye intermediates, by Germany, for example, is quite certain to lead to the control of others of our industries as well, until the penetration of our industrial fiber will resemble that of the chestnut tree by the deadly fungus which has so nearly obliterated these beautiful trees from our groves.

"10. The world markets open to other nations will be inaccessible to us."

Fungi on Frozen Meat

SPECIAL Report No. 6, of the Food Investigation Board of Great Britain has been issued in which the black spot and other types of fungi found on chilled and frozen meat are discussed. Black spots on the surface of beef and mutton brought from the Argentine and New Zealand and some other countries are commonly found upon arrival, and such meat is liable to be condemned at the port of entry. Investigation has shown that these spots are due to fungi or molds which develop when meat is stored for unduly long periods in the producing countries. The color is due to the fungus threads which permeate the superficial layers of the meat. Frequently these spots are so numerous as to overlap one another, and if too prevalent the meat is very unsightly and unsalable. The spores are carried in dried herbage or fodder which the animals are liable to be fed before slaughter, and meat may become contaminated either just before being placed in storage or while actually in storage. If during the storage the temperature rises above the freezing point or if the meat is removed from storage the spots form spores freely on the surface of the meat, but apparently no spores are formed at temperatures below freezing. Experiments have been conducted to determine under what conditions the black spot would develop in cold storage

In artificial media the fungus develops quickly, at temperatures from 18 to 22° F., and if early stages of germination are effected before subjection to low temperature, it is found that subsequent development in storage is more rapid and, with meat, more certain. Even in cases where spores were kept at from 18 to 22° F. without germination for a period of six months, they develop normally when removed to ordinary temperatures. It is believed that fluctuations of temperature even when below the freezing temperature would increase the danger of the development of black spot on account of changes in humidity and particularly if snow is deposited, this tending to collect spores present in the air and deposit them upon the surface of the meat. The fungus, however, does not produce toxic substances during growth so that the presence of the fungus alone does not render the meat dangerous or unfit for food. Indeed, the investigators have eaten large quantities of fungi mixed with other food without deleterious results. However, meat which has been in storage so long a time as to develop numerous spots of this character may easily have become unfit for food due to entirely different causes. Thus black spot may be accompanied by putrefactive bacteria.

Other fungi which may or may not accompany black spot are now under investigation and subsequent reports will deal with the exact condition under which these various forms develop upon meat

The Heavens in November, 1921

Some Details of the Great Telescopes of the Western Observatories

By Prof. Henry Norris Russell, Ph.D.

A COUPLE of months ago we had occasion to speak of the situations and surroundings of some of the great observatories. It may be of interest to supplement this by some impressions gained while watching, or sharing in, observations with some of the greatest telescopes.

The astronomical telescope if of more than a very moderate size depends for its utility almost equally upon the perfection of its optical and its mechanical parts. The importance of the former is known to everyone who possesses any astronomical knowledge. No mechanical refinements can avail if the lenses or mirrors which bring the light to a focus deviate from their appointed duty of bringing all the light which falls upon them into an image which is substantially as sharp as the laws of optics permit. It is widely known, too, how long and painstaking a task it is to "figure" a large mirror or, even more, a great lens. Months or years of labor go into the final polishing which brings the two surfaces to exactly the desired shape, and repeated careful tests, time after time, must be made before the necessary precision can be realized.

But good optical parts, however perfect, are of but small usefulness unless they are carried by an accurate strong stable and well functioning mounting and this mechanical precision becomes decade by decade, of more importance. Half a century ago, when almost all observations were made visually, work could be done, though at a sacrifice of convenience, with a telescope that lacked rigidity, so that a slight lateral pressure on the eye-end swung the image perceptibly in the field of view or with a poor driving clock, which did not follow the stars exactly, but allowed the images to drift gradually through the field or to oscillate slowly backward and forward within it. But in our days, by far the greater part of the work of the largest telescopes is done by photography—whether by making direct negatives of larger or smaller regions of the heavens, or in the study of the spectra of the stars, and in such work it is of fundamental importance to have accurate "guiding." If the image of the star wanders off the slit of the spectroscope, its light no longer enters this instrument, and the whole use of the equipment is lost until the image is brought back to its rightful place. In direct photography, especially when the plates are to be measured for determination of the positions of the stars, bad guiding is still worse. If the light of the stars fails to one side of the proper position for even a small fraction of the whole length of the exposure, the star images on the plate will not be small and round, as they ought to be, but deformed and irregular, and the effects of this distortion upon the position of the center of the image will be different for large and for small images. Such a plate will indicate a spurious shift of the brighter stars, compared with the fainter ones, and for any purpose that demands precision will be worse than useless.

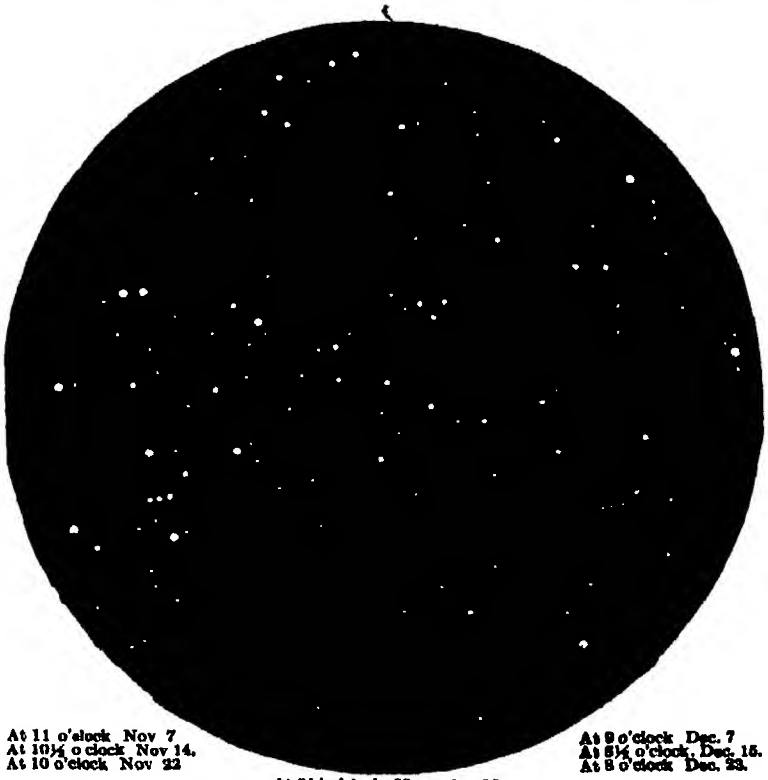
One further requirement is essential. The observer must be able to get to the part of the telescope where the light is brought to a focus, and he must be able to stay there while the instrument turns to follow the stars. With a large instrument and a long exposure this may involve horizontal and vertical displacements of many feet, and some appropriate movable carriage or platform must be devised to permit of this.

How the Big Tubes Are Mounted

The great refractor of the Lick Observatory—which has now been in active and most successful service for a generation—is a fine example of the older methods of solving these problems. The optical parts are of course of high excellence, as is the case with all other great telescopes, which have necessarily passed the strenuous tests that are imposed by their makers. The mounting is of the familiar equatorial type, with the long straight tube, on one side of the center, balanced by a counterpoise at the opposite end of the declination axis.

The observer looks directly toward the object of his study, as is usual with small instruments, and he may have to move twenty feet horizontally, and fifteen vertically, during a long spell of work on a single star. The vertical motion is taken up by that very convenient device, a rising floor, which is moved by hydraulic machinery, and can be quickly set at any desired level. An observing chair, of the ordinary type and of moderate size, can be wheeled over the floor as desired and in addition permits a few feet of vertical motion of the observer's seat. This completes the equipment.

The great reflectors produce a very different impression. To begin with, the "tube" is not completely enclosed, as with the ordinary instruments, but is of skeleton structure. The principal focus of the mirror is of course at the upper end of this tube high in the air. Small spectroscopes or plate-holders may be placed at this focus, supported in the center of the tube, but it is more usual to reflect the light again by a mirror placed near the upper end, either at right angles to the side of the tube at the top (the Newtonian form), or back down the tube and through a hole in the center of the great mirror (the Cassegrain form). The great reflectors are equipped in both these ways, the change from one mounting to the other being effected by substituting one or another "cage" or section of the skeleton tube at the upper end—each carrying its own mirrors, etc., and fitting exactly into place.



At 11 o'clock Nov. 7
At 10½ o'clock Nov. 14.
At 10 o'clock Nov. 22

At 9 o'clock Dec. 7
At 8½ o'clock Dec. 15.
At 8 o'clock Dec. 23.

At 9½ o'clock November 30

NIGHT SKY: NOVEMBER AND DECEMBER

To carry the great mirrors, which themselves weigh tons, the mountings of such telescopes must be exceedingly massive, their design is in fact an engineering problem, something like the one involved in the building of a steel bridge. To bear the weight safely is the least of the requirements. The flexure, or bending of the tube, under these weights must be so small that it does no harm, and the instrument must be exactly balanced in all positions, its bearings so perfect that a force of a few pounds can set and maintain in motion the many tons of moving parts. Moreover, all these delicate adjustments must remain correct when the telescope is pointed at any part of the visible heavens.

More than one solution of these problems is possible—indeed, the mountings of the three largest reflectors are all different. In the 60-inch at Mount Wilson the upper end of the polar axis projects in an enormous fork, within which the tube is mounted on trunnions, the point of support being close to the lower end, since the heavy mirror far outweighs the relatively light ironwork of the opposite end. This construction leaves the telescope free to point at the pole, or at any other part of the sky.

The 72-inch telescope of the Dominion Observatory at Victoria exhibits a different solution—a short, stout polar axis supported by piles at each end, pierced by a declination axis carrying the telescope on one side and a massive counterpoise on the other, so that the whole effect is much more comprehensible to the novice.

The 100-inch reflector at Mount Wilson is of such enormous size—the moving parts weigh about a hundred tons—that still another mounting was adopted. The great tube swings between two gigantic steel beams, which are united at their upper and lower ends and together form the polar axis. They are supported by massive piers at their upper and lower ends. As with the 60-inch, a large part of the weight is taken off the bearings by means of a cylindrical hollow iron float, which is partly immersed in a tank containing mercury. The space between the float and the walls of the tank is narrow, so that the quantity of mercury actually used is but a small fraction of that which is "displaced" by the immersed portion of the float, and thereby effective in producing buoyancy. With this mounting it is impossible to look directly at the pole, but this sacrifice, though serious, was judged to be worth while, in view of the great engineering difficulties of carrying so great a weight without support at both ends of the main axis.

Where the Observer Comes In

All these telescopes are provided with a very elaborate system of electrical controls. By simply pressing one of a set of buttons, the observer can move the telescope as he wishes, east or west, north or south, fast or slowly, and can also adjust the focus, and turn the dome, while an assistant at a control desk can with equal ease direct the larger movements which are necessary in shifting from one star to another. Another set of push buttons controls the motions of the observing platform. For the 100-inch telescope there are two of these. The one used when working at the Newtonian focus is attached to the dome, suspended from a curving track on each side of the observing slit, and can be moved up or down at will. It is a roomy affair, holding half a dozen visitors. At the Cassegrain focus, in this instrument the light is brought out to the side of the tube, a few feet above the mirror. Hence there is less space to spare, and the observer's platform is a narrow shelf six or seven feet long and three feet wide, with only a railing an inch or two high around the edge. On this platform the observer sits, with his feet hanging over into space.

As an example, suppose that star-spectra are being photographed. The observer looks into an eye-piece, and sees the outer surface of the slit-plate of the spectroscope, illuminated by a faint red light. This surface is highly polished and reflects the image of the star under observation. Across it runs the narrow dark line of the slit itself, but a few thousandths of an inch wide, into which the light of the star should go. Minute alterations in the running of the driving clock, or in atmospheric refraction, cause the image to shift its position, and the observer must therefore keep watch and bring it back to the right place. So perfect is the mechanism that after a few minutes' practice it is possible to bring the image to any desired point, within less than 1/500 inch on the slit-plate. The corresponding motion of the main mass of the telescope is only about a tenth part as great, yet this minute motion of the huge mass can be made with certainty!

The planetary and lunar details for the month are given on another page.

When More Voltage Means More Distance

The Limits of Long-Distance Electric Power Transmission in Terms of Today and Tomorrow

By Dr Charles P. Steinmetz

Chief Consulting Engineer, General Electric Company

WHEN about 40 years ago, Edison first transmitted electricity at constant pressure, that is, constant voltage, he used 110 volts and soon afterward 220 volts At this electrical pressure or voltage, electricity can be sent economically for about half a mile to a mile, and when it becomes desired to send electric power over longer distances, higher voltages, that is, higher electrical pressures, become necessary, just as a higher water pressure or higher air pressure is necessary to send water or air over a greater distance

Thus steadily in these 40 years, transmission voltages have been increased, until now we are beginning to use 220,000 volts, a pressure *just 1000 times as high as* that considered the highest safe pressure only 40 years ago

The question, which the layman always asks, is, "How far can electricity be transmitted economically?"

Suppose we want to double the distance to which to send the electric power This means twice as long a transmission line, and twice the cost. Therefore, to have the same economy, that is, the same transmission line cost per horsepower of electric energy sent over it, we have to send twice as much power over the line of twice the length Suppose then we use the same electric current but twice the voltage to get twice the power With the same current, the loss of power per mile of line would be the same, and as the line is now twice as long, the total loss of power would be doubled, and as twice as much power is sent over the line, the loss per horsepower of energy sent over the line is the same, that is, the efficiency of transmission is the same as before.

We see thus, that by increasing the voltage or electric pressure, and the power sent over an electric transmission line, in proportion to the distance of transmission, that is, to the length of the line, we get the same efficiency and the same economy, that is, the same percentage loss of the transmitted power, and the same (approximate) cost per horsepower transmitted.

If then at 220 volts electricity could be transmitted economically over *one-half* to one mile, at a thousand times that voltage, or 220,000 volts, as now used, it could be transmitted economically over a thousand times the distance, that is, 500 to 1000 miles, and if 100 horsepower could be transmitted at 220 volts we would have to transmit 100,000 horsepower at 220,000 volts.

As for 100,000 horsepower the generating system, etc., is cheaper per horsepower, and more efficient, than for 100 horsepower, we could in the former case allow a greater cost and greater loss per horsepower in the line, and still get the same total efficiency and economy of the system, and this would allow us to economically transmit the electric power over more than 1000 miles' distance.

Hereby all the big cities of the Atlantic seaboard and of the Middle West, New York, Boston, Philadelphia, Baltimore, Washington, Chicago, St. Louis, Pittsburgh, would be well within the radius of economical power transmission from Niagara Falls, with the present means and methods, that is, without going beyond what present experience has established as good practice.

It is not probable however that electric power would ever be sent from Niagara Falls to New York or any other of these cities, for the simple reason that in the industrial East all the millions of horsepower of electric energy which Niagara could deliver even if completely developed, would find a market and would be consumed within a few hundred miles of Niagara, long before the present day electrical limits of transmission are reached, and obviously nobody would build transmission lines to send the power over thousands of miles, when he could find a market for his power within a few hundred miles.

The question of the maximum distance over which electric power can be transmitted, therefore has *almost entirely eliminated itself as a serious engineering* problem and while electricity could be transmitted economically in large bulk, if so desired for over a thousand miles, even with the largest water powers, with rare exception, all the available water power will be taken up, and find a market, long before the electrical limits of transmission are reached

Welding the tanks for 220,000-volt oil circuit breaker now being constructed for 220,000-volt transmission line in Southern California

One of these exceptions is the Pacific Coast There the water powers are located inland, in the mountains, while the foremost market for the power is in the big cities along the seacoast. The transmission thus is all in one direction, from the east to the west, and little market for the power is near the source of power, little power found near the places of foremost power consumption

It is a very significant and well-demonstrated fact that the highest transmission voltages, *150,000 to 220,000* volts, are found in California

Another instance might be the transmission of the power of Victoria Falls in South Africa to the Rand, over 700 miles. However, it is quite possible that before this transmission is built, the country will have developed so far as to afford a market nearer than the Rand, and the experience of Niagara Falls will repeat itself

Thus today there is very little electrical power transmission of the form as understood in the early days and as the layman looks at it still today, that is, a transmission from a water power over a long line to a consumer such as a city etc

But our present day transmission lines are almost always distribution circuits and interconnecting circuits that is to say they form a part of a network of electric lines which link together various sources of electric power, water powers and steam powers and the various places of consumption, cities, mines, factories and mills, and so forth That is a network of electric lines begins to cover the country similar to the network of railway tracks, and while the network of railway tracks, built three-quarters of a century ago, takes care of the transportation distribution and supply of all the materials, so now a network of electric lines is being developed and is spreading all over the country of so adequate a volume as to take care of the transmission, the distribution and the supply as the second essential necessity of our civilization

A New Carburetor for Light Oils

A NEW apparatus invented by a Frenchman, M de Maumy, makes it possible to operate a motor by means of coal tar oils or alcohol or a mixture of the two Its principle consists in a feed operating by an automatic gage so as to maintain a constant charge of the atomizers without any previous heating of the liquid The atomizer works by a lapping or licking motion lowering the pressure in the cylinder during the intake, causing a flow of air which laps a cylinder with an undulating surface the oil is sucked in violently, being atomized by shocks and thus enters the cylinder The intake of air should be somewhat retarded, and this retardation is obtained by a modification of the cams of admission The mixture is ignited by an ordinary motor spark plug and it begins to work instantaneously either with alcohol, kith kerosene, or with coal-tar oils. Upon being tested the apparatus worked admirably It is very simple in construction, requiring neither a pump nor any sort of heating apparatus.

There is no carbonization of the cylinders even when coal tar oils are used for fuel, and the negligible amount of smoke given off shows that the combustion is excellent

This apparatus, which is capable of functioning at a low compression can be applied without difficulty to nearly all gasoline motors.

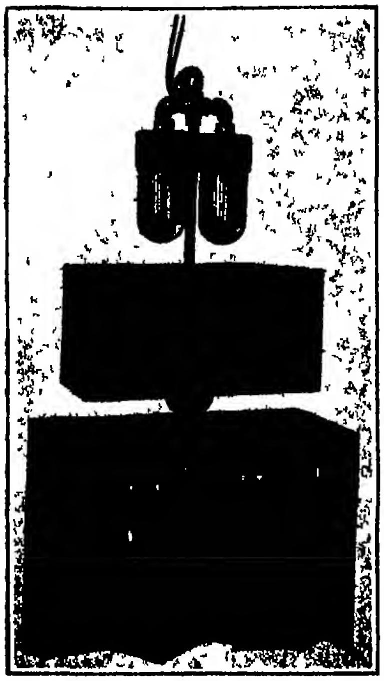
It has the considerable advantages over Diesel and semi-Diesel motors of being less complicated less cumbrous, and quite safe, moreover, the upkeep costs nothing

At the same time it is possible to make use of inferior and lower priced fuel with an efficiency almost as economical in high speed motors as well as in slower ones without making it necessary to purchase a special high compression motor, which would inevitably add considerably to the weight, to say nothing of the high price the difficulty of transport and other features that need not be mentioned but which have to be considered

These entirely new processes denote a marked advance in the solution of the problem involved in the substitution of crude oils and of alcohol for gasoline, so that they will undoubtedly rapidly come into general use

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts



This device automatically handles vehicular traffic at important street intersections

The Automatic Traffic Policeman

THE automatic traffic policeman, a quite recent invention, is placed at street intersections, in the position usually occupied by the human traffic officer. The semaphore of this device is constantly illuminated, it says "GO" for a predetermined number of seconds, then the light at the top of the machine comes on for an instant. This corresponds to the policeman's whistle, and means "Hurry across, or wait." The semaphore then turns to the next position which gives "STOP" to the street which previously had "GO," and so on.

The automatic policeman is adjustable as to intervals and hence can meet the requirements of any given corner, reducing to a minimum the amount of time people might be needlessly held up. For example, it may be set to take one minute for a complete revolution of the semaphore, divided equally or unequally, or it may be set to revolve in 30 or 40 seconds, divided equally or otherwise between "GO" and "STOP."

While it is new to the market, it embodies only proven mechanical principles—an electric motor and a Geneva cross movement being the two major parts.

A German Version of the Motor Wheel

SOME ingenious German inventor has taken our American motor wheel, which fastens alongside the rear wheel of any bicycle, and made it over into something that is sufficiently different to possess several talking points in its favor. As will be noted in the accompanying illustration, this German motor wheel is carried at the rear of the bicycle by means of a long arm. It would appear that such a motor wheel can be readily attached to any bicycle, and that because of its distance away from the cyclist there is no danger of dirt or smoke or smell. Just what complications such a pushing device may introduce in steering, we are not told. At any rate, the motor wheel is said to push any bicycle over 30 miles with one gallon of gasoline, which is not as efficient as some of our American types.

German motor wheel which fastens on behind a bicycle by means of a long arm

Another Attachment for the Phonograph

THE latest invention destined to improve and amplify the tone of the usual phonograph is a little device that is attached on the usual sound box. It depends for its performance upon a vibrating disk of special composition which, so it is claimed, takes up the vibrations from the needle and tends to amplify and clarify them, before they are transmitted to the sound box diaphragm.

The little disk attached to the usual sound box is said to improve phonographic reproduction

A Folding Wheelbarrow

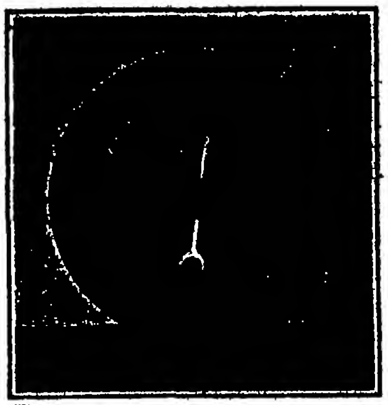
FROM France comes the idea shown in the accompanying illustration, namely, a folding wheelbarrow. The French inventor explains that there is need for a folding wheelbarrow, especially in winter time when it can be folded up and taken into the house, there to be stored in a closet or some other out-of-the-way place. At any rate, the construction is neat and quite practical, we gather from the two photographs.

The folding wheelbarrow, in use and folded up for putting it away during idle moments

A Wireless Meter for Testing Starting Systems

THE little meter, which is shown in the accompanying illustration, has been designed for the purpose of locating ignition, starting and lighting troubles in the usual automobile. There are no wires to disconnect, there are no wires to connect. Indeed, this instrument is truly a wireless type. The operation is simple—just place it on the wire to be tested and the meter indicates the amount of current, if any, flowing through the wire.

This little meter consists of a main instrument having a 30-ampere divided scale. That is, the scale may be read either way, depending on whether the wire is the positive or negative wire. The instrument is fitted with a 300-ampere magnetic shunt, which is a steel ring that fits around the meter casing. This shunt is used when testing high ampere current ranging from 30 to 300 amperes, and is principally used for starter work, while the 30-ampere scale is used in lighting, ignition and, in fact, for all circuits of relatively small current flow.



The simple type of ammeter which indicates current flowing through wires, without connecting it

An Improvement in Oil Cups

BY making use of a small steel ball which is pressed down by spring against the opening of the stem so as to regulate the distribution of oil, a newly-introduced lubricating device is claimed to represent a marked economy in lubricating oil consumption. In fact, this new oil cup is said to save from 40 to 60 per cent in oil consumption on various kinds of machinery on which it has been employed. It places the oil in such sufficient quantity as needed for proper lubrication and eliminates all waste, therefore doing away with drip pans and making for clean walls and ceilings in the shop and factory. By the same token it lengthens the life of belting, since it prevents oil from coming in contact with the belts.

The ball lubricator cups are automatic in operation, feeding the oil when the machinery is running and stopping the feed when the machinery is at rest. This eliminates the danger of burning out bearings through failure to turn on the oil when machinery is in use, or through failure to shut off the flow at night when the day's work is done, thus allowing the oil to run out of the cup and on to the belting and floor. The ball cups require a minimum of re-filling.

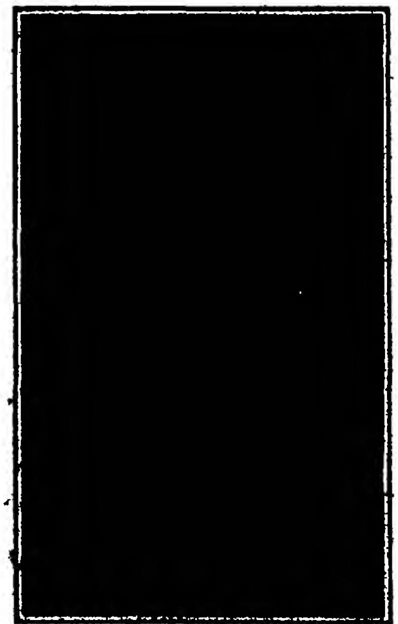
A Thief-Proof Alarm for the Automobile

THE prevention of automobile theft now takes a new turn. Instead of applying all manner of locks, ignition safeguards, chains, tire rings and free steering wheels that cannot steer, there has been developed an alarm which, when mounted on any automobile, advertises the fact to everyone when the automobile is being tampered with by an unauthorized person.

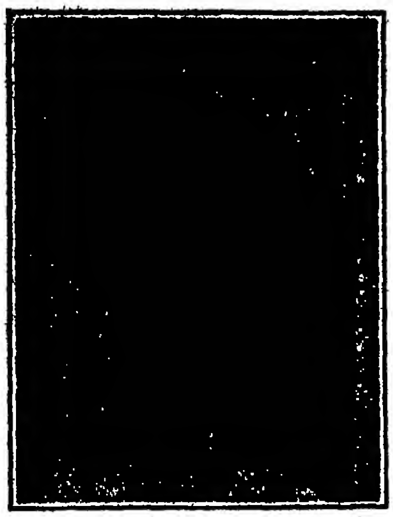
This new device is a well-protected, self-contained alarm which is placed on the running board of any car, and is always visible. The alarm is contained in a heavy aluminum case which is bolted or riveted to the running board in such a manner that its removal requires considerable time, during which the alarm must sound. There is nothing intricate or complicated about the device, but it is fully protected and cannot be silenced by application of high-voltage current, or in any manner, except by spending an hour dissembling it. A special large gong bell is installed inside the case, and draws approximately ½ ampere. The current is supplied by three standard dry cells, mounted within the case.

It appears that this device makes use of a floating, compensating mercury switch which gives instant and continuous contact under lateral vibration, and no contact under vertical or road vibration. The switch is thrown into contact by a 12-key push-button combination switch, which, so it is claimed, gives over 1,000,000 combinations. To ensure against tampering, the upper and lower halves of the case are made a circuit, so insulated apart that until the case is sprung or tampered with the circuit is open. Any attempt to force the case will close the circuit and cause an alarm.

When a car is to be left standing, the



Automobile theft alarm with cover open to show the push-button combination switchboard



This little device, when held up to the light, gives a definite exposure for the photograph

top of the device is opened and the proper keys depressed to set the alarm. If anyone raises the hood of the car, steps on the running board, tampers with spare tires or otherwise touches the car, the sensitive mercury switch closes the circuit and the bell rings continuously until the owner of the car resets the device.

Correct Photographic Exposure at a Glance

AN ingenious little device which measures light in a manner analagous to the way in which a scale weighs a substance, has been invented by a San Francisco man. It will be of inestimable value to photographers, both amateur and professional, for it is a well-known fact that photographic value is often far different than the apparent brightness of the light.

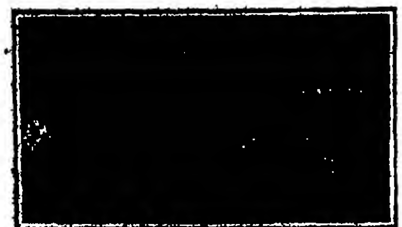
The device must not be confused with so-called "exposure meters." It has no settings to make, no calculations to figure out, and nothing to look through. It is self-acting and requires no factors or tables in its manipulation. Instead, it is simply pointed at the source of illumination—sun, window, or whatever it may be—and the intensity of the light is instantly shown. A corresponding dial indicates relative exposures and stop-settings for the camera for that particular light.

The little light meter is about the size of a silver dollar and as it requires no adjustments or settings, its value to the "kodaker" or to the professional photographer is apparent, for it does away with the dread "trick light" miscalculation which every photographer knows too well.

From Coffee Container to Galvanized Egg Cartons

A HOOSIER wholesale grocer packs coffee in a new way—one which is very attractive to the retailer as well as to the freight agent who handles it.

The coffee cartons, one pound packages, are placed in galvanized containers and sealed These containers have a lid and a bale for handle, admirably protecting the contents against damage in handling. When their use as coffee containers is finished the farmer can then use them for his egg crates, as the wholesaler has obligingly inclosed the little pasteboard separators. These egg crates have a capacity of twelve pounds and cost the farmer approximately $4.80. The egg crate alone would cost him $1.50, so he gets a first class grade of coffee at only about 27¼ cents. This makes it a very attractive proposition to him, as he can find a thousand and one uses for galvanized crates besides the one above mentioned.



A coffee dealer packs his cartons in iron containers, which can be afterwards used for other purposes

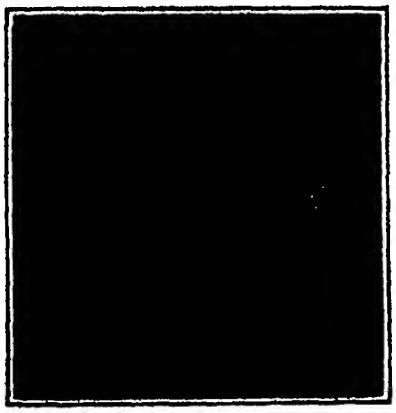
Something New and Better in Folding Tables

FROM France comes the idea for a folding table which is shown in the accompanying illustration. This table, it will be noted, has telescopic wooden legs of much the same design as the usual camera tripod legs. The object of this construction is so that the table can be levelled anywhere, no matter how irregular may be the ground on which it is placed. The table is primarily intended for picnics, although it may be used for playing cards, making maps, as a desk for military men in the field, as a serving table, and for all purposes where a strong but portable table is desired. A small compartment in the table top holds playing cards, paper, writing materials or other things.

Simple folding table intended for automobilists, campers and soldiers in the field

A Self-Teaching Musical Instrument

A NEW YORK inventor has developed a simple musical instrument which may be played by anyone without previous experience. The principle of operation is simple enough. A musical score is furnished in the form of a little card which contains a succession of letters. These letters correspond to the letters of a scale in front of which swings an indicator The player brings the indicator in line with the first letter indicated by the card, and blows into the mouthpiece, and then sets the indicator to the second letter, blows again, and so on. Moving the indicator causes a piston to be shifted in the cylinder of the cylinder, thus changing the pitch.



A simple little musical instrument which enables anyone to play popular airs

Tractor Operated Cotton Picker

ONE of the seasonable occupations in the cotton belt is cotton picking and while this has been done by human labor for many years, new machinery has been developed that makes cotton picking a simple, mechanical operation.

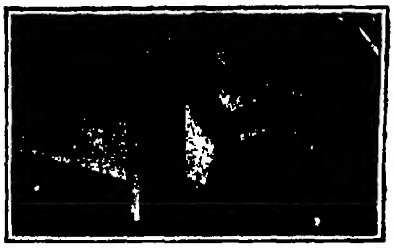
A concern in St. Louis, Mo., which controls the Thurman patents is build ing a picker than can be utilized with any tractor, and claim is made that with six men it will do the work of thirty-six hand pickers and do the work 25 per cent cleaner Very great economy is claimed on the basis of a capacity of 3,600 pounds of cotton a day for the machine and six pickers as compared with the average of about 100 pounds a day for good hand pickers. The vacuum picker consists essentially of a large metallic storage tank mounted on two wheels which is coupled to and is transported by a farm tractor which furnishes the power to drive a specially designed vacuum pump. When the pump is in service it is driven by a chain belt from a pulley The chain may be driven by the same drive shaft that is used for belt power and engaged or disengaged as conditions may require.

The pump exhausts the air from the tank, which is tightly closed In an upper compartment of the tank are six inlets to which are attached lines of hose, that have one inch diameter at the nozzles and increase to 1½ inches diameter at the inlets. At the end of each tube is a "Y" on the arms of which are intakes, there being twelve of these in all

The hose is supported by the waist belts of the pickers, who hold a nozzle in either hand The opening and closing of the nozzles are controlled by levers, operated by the fingers. When a nozzle is applied to a boll the cotton is drawn from it by the suction and drawn through the tube into the tank The tank has a capacity of about 400 pounds of cotton and when filled it must be emptied The tank is quickly discharged by dropping a circular trap or door at the rear of the tank and placing a cloth sack about the opening The exhaust from the pump is turned into the tank and the cotton is blown from it into the sack, which is then tied and piled or hauled from the field The maker claims that when the tank is full this fact is registered

The truck that carries the tank is substantially built, a frame in which the tank is mounted being carried on an axle and two wheels. The tank is 86 inches long and 42 inches diameter The frame has a drawhead and this may be coupled to the drawbar of the tractor

The tank is steel and it is surrounded by a wire rack for carrying the hose when not in use or the picker is being transported In the upper compartment of the tank is a gage that registers the degree of vacuum In this compartment, above the intakes, is a screen that prevents the cotton being drawn into the vacuum pumps. The vacuum pump or blower is supported by two brackets bolted to the differential housing of the rear axle of the tractor, when this is possible or on some other unit where it may be driven by the belt pulley shaft, a small chain sprocket being substituted for the pulley



The simple pushing of a tiny lever swings out the desired arm for warning the driver behind

Posting the Driver Behind

THE latest addition to our already large collection of published inventions of the automobile signal class, is presented in the accompanying illustration It consists of an arm and a case containing a collection of arrow shaped arms which read "Stop," "Left" and "Right," a red light which flashes red and illuminates the arm at night, and a collection of controls located within convenient reach of the driver The driver, by means of this device, can swing out any desired arm so as to keep the drivers behind him posted as to his next move

Automatically Closing Fire Doors

DESPITE the proven worth of the automatically closing fire doors, it is surprising to note the marked absence of such safety devices in many plants where they would undoubtedly give a great measure of protection in the event of fire These doors permit of free access to and from all parts of a factory during normal times, but automatically swing closed at the first signs of fire They are quite effective in preventing the spread of fire from one part of a building to another, as indicated by severe tests and in actual fires

Two Drums in One

AN empty drum—and that means the usual drum—wastes a great deal of space Why not put the various drum sticks and other paraphernalia inside the usual large drum? That is what occurred to a Brooklyn inventor, who has worked out a drum which can be used for carrying a smaller drum and all the paraphernalia necessary By merely unlatching and swinging open a section of the large drum various articles may be placed inside for the sake of greater portability

This large drum may be opened so as to place a smaller drum within it for greater portability

A Trailer to Carry the Tractor

THE practice of carting tractors throughout the farming regions of California for demonstration purposes is becoming very popular with a number of dealers in that State. One can now buy a low-bed trailer, capable of carrying these tractors over the highways while being towed by a passenger car or a light delivery truck. This effects a great saving over the former method of using a special truck.

This trailer is equipped with a bed which can be tipped so that the rear end rests on the ground. The tractor is then run on to the bed by its own power, and the bed automatically tips to the carrying position shown and is locked in this position by a spring catch. When it is desired to unload the tractor, the operator lifts up on a handle which releases the bed and permits it to tip when the tractor can be run onto the ground.—*By C. W. Geiger.*

Carrying the tractor to the job on a trailer is often more economical and convenient than driving it under its own power

A New Multiplication Machine

A NEW machine, called the "multi," has just been added to the list of computing devices in current French use. It gives quickly the product of any multiplication. As can be seen by our photographs, it is remarkable for its simplicity and its compactness. It comprises neither springs, gears nor other complicated parts.

The "multi" comprises a frame on the upper part of which seven axes can turn. Each of these supports multiplication tables wound on parallel cylinders disposed in such a way that only one of their columns appears at a time in front of the operator. The units in each column are separated from the corresponding tens columns which are carried over to the left against the units of the next set of numbers.

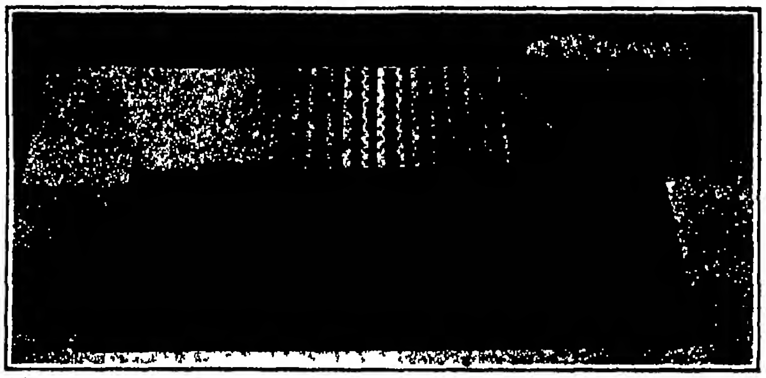
The putting together of these tables or of a part of these tables forms the multiplicand which appears in its normal order on the first line of these columns, in figures with a red circle around them. The multiplier appears on a moving carriage on sliding bars, containing nine rows of five "windows" numbered vertically from 1 to 9. By opening some of these "window blinds," which are of equal size to the columns of the multiplicand, the multiplier is formed.

The inscription of the figures of the latter on the carriage is made in reverse direction to the multiplicand. In other words, the units are on the left, the tens on the right of the units, the hundreds on the right of the tens, and so on and so forth. The zeros are written by leaving shut all the blinds on the corresponding columns.

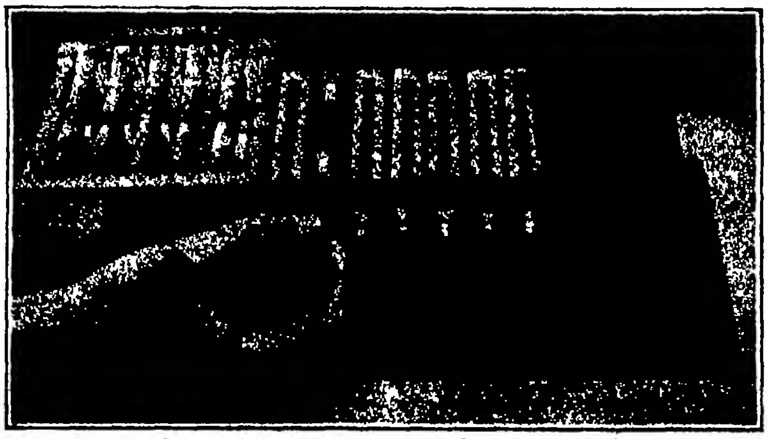
The various wheels of the "multi" reproduce mechanically the elementary operations of which an ordinary multiplication is composed. First, it is necessary to make a series of multiplications of a single digit by a single digit, the quantity of these multiplications equalling the product of the number of digits of the multiplicand by the number of digits of the multiplier; then the addition of these partial results follows, and finally the inscription of the result obtained.

To make these successive operations with the new machine, the adding-multiplying carriage is slid over to the right up to the tabulating stop. The multiplicand is then formed by revolving each axis so as to bring the necessary figures in front of the operator. If the number is composed of only three or four figures, the other figures are concealed by means of a blank, in order to avoid the unused columns appearing as zeros. The blinds necessary for making up the number of the multiplier are then opened on the adding-multiplying carriage, care being taken to remember that this number must be made up from right to left. Thus, 456 would be written 654.

Consequently, the first vertical row from the left side represents the units on the multiplying carriage, the second row from the left, the tens, the third row, the hundreds, etc., etc.



The new French multiplying machine, which gives quickly the product of any multiplication. It contains no springs, gears or other complicated parts



Setting the "multi" preliminary to operation, showing the method of rotating the seven numbered axes to obtain the correct initial setting

Once the factors are thus composed, the multiplying-adding carriage is displaced from right to left up to the second tabulating stop. The units column of the multiplier then places itself at the left half of the units column of the multiplicand (the tens of this column) and at the right half of the tens column of the multiplicand (units of this column). In the units window of the multiplicator, two numbers can be read (which may both be equal to zero). The first is the number of the tens of the partial product of the units of the multiplicator by the units of the multiplicand. The second is the number of the units of the partial product of the units of the multiplicator by the tens of the multiplicand. The operator notes them.

At the same time he brings the column of the tens of the carriage in superposition with the column of the units of the multiplicand. He reads through the window of this column a number which is that of the units of the product of the tens of the multiplicator by the units of the multiplicand. The total of the three numbers which appear through the open shutters is the number of the tens of the product. If this number is superior to 10, the figure at the left is carried forward and added to the figure of the hundreds, which is obtained by moving the carriage to the next stop at the left.

It is then sufficient to read the following:

First—*Through the units window of the carriage*, the tens figure of the product of the tens of the multiplicand by the units of the multiplier, then the units figure of the product of the hundreds of the multiplicand by the units of the multiplier.

Second—*Through the tens window of the carriage*, first the tens figure of the product of the units of the multiplicand by the tens of the multiplier, then, the units figure of the product of the tens of the multiplicand by the tens of the multiplier.

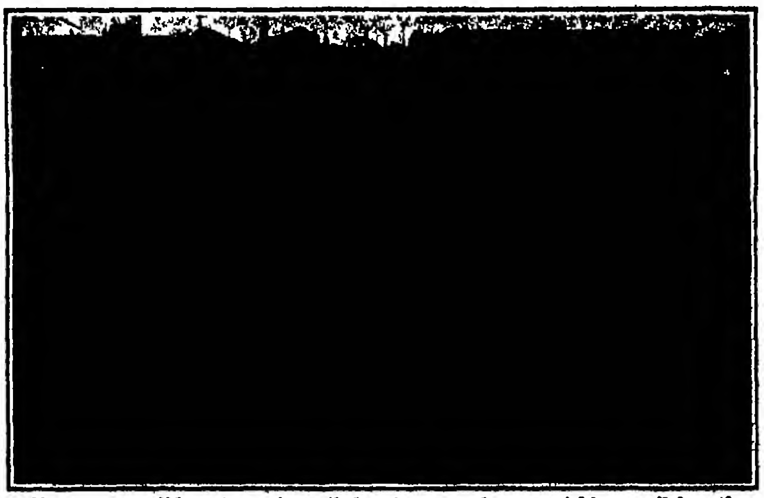
Third—*Lastly, through the hundreds window of the carriage*, the units figure of the product of the units of the multiplicand by the hundreds of the multiplier, and so on and so forth.

In conclusion, in order to make an operation with the "multi," the multiplicand is written on the first line of the cylinders by the successive rotation of the latter around their axis, then the multiplicator is written by opening the corresponding windows for each column of the carriage, the latter is then moved up by means of the tabulator stops, and after having sent it back to its normal position, the open windows are shut (by means of the blinds) and the machine can be used again.

A Bumper that Slides Along the Track

A BUMPER has been perfected that eliminates many of the dangers met with in the use of a rigid bumper for railroad cars. The one main advantage with the new bumper is that, when moving cars into track, the instant the first car strikes the shoes the whole crew knows it and they all realize that they are coming to the end of the track, and it is the engineer's duty to stop, whereas in the case of a rigid bumper, the first notification the crew has that the cars are at the end of the track is a sudden jolt, and with the coming of this jolt the damage has been done. With the use of most types of rigid posts there is always a possibility of injuring the post or displacing the track.

This bumper is designed to be used on the blind end of a track. The sliding shoe catches the car wheel and is forced along the rail, creating a very high friction which effectively retards the momentum of the car wheel within a rail length.—*By Geo. F. Paul.*



The bumper slides along the rail, but it stops the car within a rail length without excessive shock or strain

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AEROPLANE.—W F OSBORNE Wagon Mound, N M. The invention relates more particularly to an aeroplane embodying means by which to counteract crossing on counter air currents, as well as to neutralize to a considerable extent the effect of striking air pockets. Among the objects is to provide means adapted to act as a stabilizing arrangement and to assist in both climbing and descent of the aeroplane, as well as to increase its normal capability as to safe maximum speed

AIRSHIP.—K. A ENLUND, South Nyack, N Y The invention relates generally to airships and more particularly to that type of airship embodying a part of longitudinal parallel rigid gas containers, the object being the provision of a construction applicable alike to large or small airships and of a nature which will afford maximum protection and safety with speed and effectiveness, especially as regards lateral stability

Electrical Devices

ELECTRIC VAPORIZING GASKET.—W KUTSCHE, 1302 Washington St, Lincoln, Neb An object of this invention, shown in Fig 4, is to provide a gasket to be clamped between the intake manifold and outlet of the carburetor, embodying an electric resistance disposed across the path of the fuel to heat and vaporize the latter as it passes through insulating pieces are laid above and below when the gasket is clamped between a manifold and carburetor

COMBINED TOOL POUCH AND TESTING DEVICE.—A E SHARKEY, 263 No. Front St, Cuyahoga Falls, Ohio A purpose of the invention is to provide a device which is simple and inexpensive, and which may be readily carried on the belt of a repairman in position to facilitate testing without removing the device, the tool pouch being also carried in convenient position to permit the ready insertion and removal of tools used in repairing of electric apparatus.

ELECTRIC STOVE.—A. C HARRINGTON, Marion, Va An object of the invention is to provide a simple compact electric stove in which the generated heat is under a much finer degree of control than is usually the case. A further object is to provide a thermostatic device and means whereby the heater circuit may be opened and closed at predetermined temperatures by the use of a simple means in connection with the thermostat.

CURLING IRON.—T L. DENNIS, address Geo. F Parker, 119 W 42d St., New York, N Y An object of the invention is to provide an electrically-heated curling iron wherein the heating medium is so positioned as to produce the desired results without interfering with the movable parts of the iron A further object is to provide a curling iron with a hair retaining member, so pivoted that the thumb is raised only a minimum distance from the handle when actuating the same and to offer as little obstruction as possible in curling

Of Interest to Farmers

HOG FEEDER.—F H. PAGE, Waverly Iowa. The invention relates to a feeder in connection with a hopper and adapted to be actuated by the animal for feeding a limited quantity at each operation An object is to provide a feed box with a flapper bar near the bottom in order to prevent the animals playing with the mechanism, and a covering member arranged with means for holding the same against removal while allowing a partial opening for refilling purposes

CLEVIS.—W PORTER, R F D No. 5, Aurora, Oregon. An important object of the invention is to provide a pin and clevis device of the type used as draft couplings in agricultural implements, vehicles or the like and which will prevent the accumulation of dirt, sand, or other foreign matter around the lock joint. Another object is to provide a device which is self-locking simple, and in which there will be little liability of its catching on other working parts.

DEVICE FOR GRINDING TRACTORS.—E E. PYLE, Morris, Ill. Among the objects of the invention is to provide a device for grinding tractors of various types in which means is provided for holding the steering apparatus used in plowing in such position as to keep one of the front wheels of the tractor in a furrow The device can be quickly attached to the steering apparatus of a tractor without altering the structure in any way

ATTACHMENT FOR FARMING IMPLEMENTS.—J F COOK, 846 Brunswick St San Francisco Calif The purpose of the invention is to provide a simple attachment which can be applied to any standard form of two-wheel farming implement by a slight modification of the latter for converting the implement into a self-propelled one or into a tractor which can be utilized for drawing farming implements. The invention further provides means for driving the wheels of the implement, such means being readily attachable and constructed to allow for differentiation in movement of the wheels.

PORTABLE IRRIGATION APPARATUS.—W F GRIFFIN, Watonga, Okla The invention has for its object to provide a portable irrigation apparatus which is light in weight and which may be used economically for field crops. A further object is to provide the apparatus with a system of pipes, bound firmly together and mounted on standards provided with casters, it being possible to raise the pipes when they are to be moved to a new position, so that they will not interfere with the growing plants.

POWER-DRIVEN FARMING IMPLEMENT.—J T HICKMAN, Jr, Springport, Ind The main object of the invention is to increase the range of use of the power-driven implement and bring about delicate directional control so that it can be turned practically in its own length with ease, and further objects relate to the mounting of the ground wheels whereby the machine may proceed without difficulty over uneven, rocky soil, avoiding injury from the encountering of obstacles.

MANURE REMOVER.—S. E BROWN R F D No. 4 Middlebury, Vt. The general object of the invention is to provide a flexible carrier adapted to operate in a trench beneath a stable and adapted to carry the manure therefrom outwardly as well as to provide for automatically scraping the manure from the carrier to direct it into a wagon

Of General Interest

PROTECTING DEVICE FOR FRUIT JARS AND THE LIKE. C W YOUNG 745 E Julian St, San Jose Calif The primary object of the invention is to produce a device which may be applied to fruit jars to protect and prevent the same from cracking when hot fruit is poured into them The device is extremely simple and consisting of a funnel a protecting shield, and a supporting rod extending into the jar It may be manufactured and sold at a low cost (See Fig 3)

ATTACHMENT FOR T-STANDS.—J S ADAMSON, 221 F Houston St San Antonio Texas. The object of the invention is to provide an attachment especially adapted for displaying compo-board and the like but also adapted to display articles of merchandise of any character, and adapted to be attached to a stand having a vertical rod in such manner that the attachment may be adjusted easily attached to and removed from the rod, and the article adjusted toward and from the rod (See Fig 1)

THREAD GUIDE AND SUPPORT.—J W OLIVER and H BRUCKER, address J W Oliver 16 E 33rd St New York N Y This invention relates to a simple and economically manufactured thread guide and support which may be readily attached to the hand of the person using it and in which the thread is led from the spool through a guide or shuttle on the support in such manner as to eliminate any tendency on the part of the thread to unravel or snarl The device shown in Fig 2, is made of aluminum, thus reducing its weight to a minimum

SHAVING BRUSH.—P P PUPILLA, 813 Forest Ave, Bronx N Y The invention relates to a brush by means of which it is possible to either apply soap to the bristles of the brush, or that portion to be shaved and to mix a separate and independent lather for each person A further object is the provision of a brush which will carry a supply of water, and provide an adequate amount instantly for use in forming the lather of proper consistency

DISPENSING APPARATUS.—J H LIMPERT, c/o Limpert Bros., 825 Greenwich St., New York, N Y An object of the invention is to provide an apparatus whereby coffee extract may be mixed with boiling water Another object is to provide means whereby the proportions of water and coffee extract can be regulated by the manipulation of a single handle which controls the flow of the water and coffee into the receptacle

SILO HOOP TIGHTENER W ZULCH Cobleskill N Y This invention relates to hoop tighteners which will serve the double purpose of a tightener and a ladder The device is comparatively easy to install and although primarily intended for use on silos may be utilized successfully on vats or similar types of containers which employ hoops.

COMPOSITION FOR MATCHES AND PROCESS FOR MAKING SAME.—M PRADO Santiago Chile An object of the invention is to provide a paste for matches which will have a low specific gravity and contains a minimum of potassium chlorate and a substance which will prevent the natural decomposition of the potassium chlorate The composition contains such reactive materials as saw dust, coke etc. which have a low specific gravity and are highly inflammable

COMPOSITION OF MATTER.—S BREITHOLTZ 220 Madison Ave New York, N Y This invention relates to a composition to be baked into a pie crust It consists of the following ingredients in about the proportions specified namely two cups of white flour one cup of butter and two tablespoons of tea infusion, produced by soaking one-half teaspoon of tea leaves in a tumbler of water

MANUFACTURE OF ALKYLENE CYAN HYDRINS.—W Bauer c/o Rohne & Haas, Darmstadt Hessia Germany The process relates to the manufacture of alkalcyanhydrins from alkylenehalogrenhydrins and a solution of cyanid characterized thereby that the change takes place in a pure water solution under the influence of cooling The process of preparing ethylenecyanhydrin which comprises causing a re-action between ethylenebromhydrin and potassium cyanid dissolved in water at a temperature of 55° to 60° C

DOLL.—E A ABIER c/o John A Poulson, 5th and Market St Chester, Pa The prime object of the invention is to construct a doll in such a manner that any one of a plurality of facial expressions may be displayed at will A further object is to so construct the head of the doll as to render the same capable of rotation about a vertical axis to dispose one of the several facial expressions in display position

ILLUSTRATED CODE.—L. HARMUTH c/o F Roch 8 E. 13th St New York N Y This invention more particularly relates to a code for use in connection with wearing apparel. An object is to provide an illustrated code which will permit of a person sending a message in code form which will relate to articles composed of a number of separate units grouped together to form a complete whole. Thus a person receiving the message will be enabled to comprehend what the sender desires.

LIGHT SHIELD.—O P SMITH 23 Ricarde St Worchester Mass, A nobject of this invention is to provide a device in the form of a strip which may be attached around the edge of a door frame to prevent light from passing through any cracks or crevices. A further object is to provide a strip primarily designed to keep undesirable light out of dark rooms, such as are used by photographers which may be temporarily attached without scarring of the wood work

CONTAINER.—C H CASTLEDINE 5020 Saul St Frankfort Pa The invention relates to containers more particularly adapted for containing and dispensing liquid products, such as salad oils, evaporated milk syrups etc An object is to provide an effective draining of the contents to prevent waste in dispensing from the container by the flowing of the contents over the outer surface The device is of ordinary construction as commonly used, but with a vertically extending drainage channel in which an opening cut is made

POURING ATTACHMENT FOR CANS.—G C SWEENY, 144 Columbia Heights Brooklyn

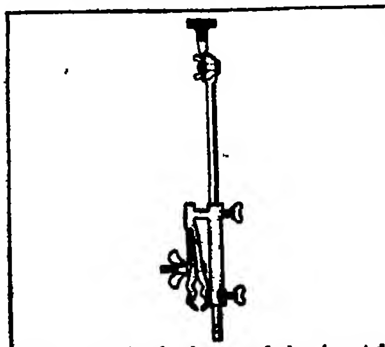


Fig. 1.—This handy clamping device, invented by J. S. Adamson, is intended for use with T-stands.

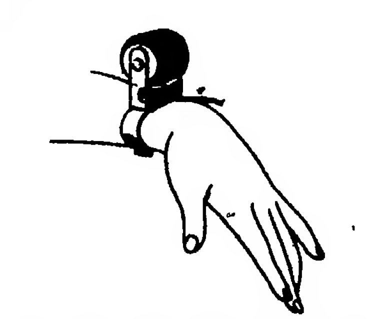


Fig 2.—Here is a novel thread guide and support which is worn on the wrist. It is the invention of J W Oliver and H. Brucker

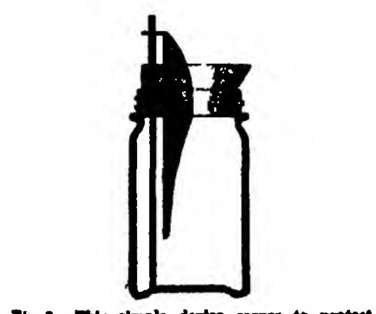


Fig. 3.—This simple device serves to protect fruit jars from cracking when pouring hot preserves into them. It is the invention of C. W Young.

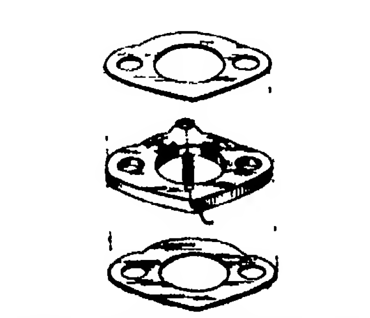


Fig. 4.—The heating and better vaporization of fuel for the gasoline engine is the object of this special gasket, invented by W Kutsche.

N Y The invention relates to pouring attachments for metal cans, commonly employed for shipping gasolene oil and other liquids. An object is to provide a device in which a reversible funnel facilitates the filling and emptying of the container A further object is to provide a pouring attachment which will be simple, strong and comparatively inexpensive to manufacture.

FILM-FEED APPARATUS FOR PROJECTION DEVICES —C H McQuillan c/o Press Gazette Green Bay Wis. The purpose of the invention is to provide a film holding and feed device from which the film may be fed from its center into and through the projecting box and from the latter on to a take-up wheel, the hub and one side of which are detachable with respect to the opposite side so that the film may be bodily removed and reinserted in the feeding reel or holder

BASKET —C F Rothwell, Columbus, Mont The object of the invention is to provide what is known in the undertaker's business as a 'pick up' basket A further object is to provide means whereby the manual lifting of a corpse from the basket on to the embalming table is eliminated and the operation thus made more sanitary, and the danger of spreading disease lessened

TOW LINE.—J Duggan, R F D No 2, Watervliet Mich The invention relates to tow lines particularly adapted, although not necessarily for use in hauling stalled motor cars, a purpose being to provide a simple line comprising a main section, and branch sections having their free ends formed with eyes, and having knotted ends, adapted to extend through the eyes and locking blocks, slidably fitted on the eyes for locking the knotted ends with the eyes.

CLIPPING DEVICE.—W Gowen, 90 W 11th Ave, Tampa, Fla This invention relates to hand-operated clippers adapted for use in gathering fruit, flowers, and the like, from trees and bushes. The purpose is to provide a clipping device which is of extremely simple and inexpensive construction, and capable of being secured to the hand and operated by the thumb and forefinger, leaving the three fingers and the palm of the hand free

PROCESS OF MAKING ARSENATE OF LEAD —M L Towne, address The Niagara Sprayer Co, Middleport N Y The invention has for its object the production of a soft, fine precipitate of arsenate of lead which is suitable for use as an insecticide with little grinding Another object is to provide a process in which a means is provided for reducing the percentage of soluble arsenate in the insecticide below the amount which is permitted by the laws controlling the quality of insecticides.

PROCESS OF MAKING LEAD ARSENATE. —M L Towne, address The Niagara Sprayer Co Middleport, N Y The invention relates more particularly to a process of the class indicated in which a catalyst is used to hasten the reaction between the litharge and arsenic acid An object is to produce lead arsenate having a low solubility so that the recovery in filtration will be maximum, and the lead arsenate especially suitable for use as an insecticide.

CARPET OR THE LIKE MOUNTING FOR STAIRWAYS.—C D Armstrong, 2405 Harrison St San Francisco, Calif The invention relates to means for mounting carpet or the like on stairways, and has reference more particularly to a plate made to receive the strips of material to be mounted and maintain them in fixed relation, relative to the steps to be covered. The primary object is to provide a simple means of repairing steps in which the carpet or covering has become worn

THREAD GUIDE AND SUPPORT —J W Oliver, 16 E. 33rd St., New York, N Y This invention has for an object to provide a light support in which the liability of the thread to snarl or become unreeled from the spool beyond a required amount is prevented, and by reason of the narrowness of the aperture through which the thread passes it will meet with more or less friction, thus will not run too freely The device is constructed to be worn on the wrist for the user

COMB —O R. Altwein, P. O Box 798 Asheville, N C The invention relates more particularly to combs designed for straightening kinky hair, an object being to provide a comb in which a movable member operates to clamp or frictionally bend the hair between the same and teeth of a stationary member, so that when the comb is moved through the hair, it will operate to straighten the hair, especially when the comb is heated.

SMOKING PIPE.—H J McGuckin, 668 8th Ave., New York, N Y Among the objects of the invention is to provide a construction wherein the tobacco is protected at all times and is positioned so that the smoke will readily pass out of the mouthpiece. Another object is to provide a round-shaped bowl with an opening in line with the mouthpiece, whereby a good draft will be produced and the tobacco will be protected against rain

GAZING BOWL.—L. M. Anderson, Box 31, Station I, New York, N Y In general the invention relates to a receptacle having a highly polished interior surface, which may be filled with liquid to form a reflecting surface into which a person, using the device, may gaze, whereby the concentration of their thoughts may be assisted Another object is to provide a receptacle which is artistic and ornamental.

Hardware and Tools

TOOL.—A J Burke, 105 Plymouth St., New Haven, Conn The invention relates to an auger which is especially constructed for boring through seams or season-checks, an object being to prevent the chips or borings lodging in the seams and clogging the tool causing a loss of time to the operator, the upper edges of the tool is formed with a series of teeth and upon being actuated in the usual manner any chips will be effectually removed from the bore. (See Fig 6.)

CONTROLLING MEANS FOR SPRING OPERATED FAUCETS —G A. Hickman, Box 634, Pearl River, N Y This invention, shown in Fig. 5, provides a device of simple and durable construction, reliable in operation, easy and inexpensive to manufacture, and effective to control the flow from the faucet, so as to maintain and vary the flow as desired The controlling means includes a swinging cross head, a clamping bar, carried by said cross head and a clamping screw carried by the clamping bar for engaging the spring faucet.

LEVEL HOLDER.—F. Butler, Panama Hotel, 403) 5th St., Los Angeles, Calif An object of the invention is to provide a level holder which will receive the ordinary type of pocket spirit level and support the same against a straight edge, so that the level can be used as an extended surface. A further object is to provide a device which can be manufactured and sold at an extremely low price

LOCK.—F J Dowling, 425 W 124th St., New York, N Y Among the objects is to provide a lock having safety means serving automatically to close the key opening in the event that the key barrel is severed from the lock. A further object is to provide means whereby the sliding or bolt portion may be held in either of two positions, one of which is for holding the bolt projected in position to be further projected by the door jamb, the other position is to prevent cooperation with the door jamb device.

WOOD SAW.—R. A. Heisel, c/o Eli Jones, Laverne, Minn. This invention relates more particularly to a pole or core-wood cross cut saw, an object being to provide means for preventing rattling, vibration and lateral displacement of the saw frame and means for facilitating the movement of the saw frame during its operation A further object is to provide a saw which is strong, durable and capable of adjustment.

CROSSCUT SAW EQUALIZER.—L. E. Killian, Fillmore, Ill. An object of the invention is to provide an attachment for cross-cut saws which will enable a single operator to efficiently operate the saw, giving him the necessary purchase and leverage so that he can effectively use the saw in any cutting position. A further object is to provide an equalizer which can be conveniently attached to any ordinary saw.

CALIPERS.—W H Harris, Laurium, Mich. The primary object is to provide a caliper in which the legs thereof are automatically maintained in contact with the work by mechanical means instead of depending upon the gripping action of the hand of the operator, as is the common practice The device is particularly adapted for determining and marking the center of a body for which purpose a centering rod is provided.

GATE VALVE.—J C Smith, 55 John St., New York, N Y The invention particularly relates to outside screw and yoke gate valves using a yoke sleeve or bushing. An object is to provide a gate valve whereby the yoke sleeve or bushing can be readily removed, replaced or repaired without disturbing the yoke, whether the latter is cast solid with the bonnet or forms a separate part.

PIPE PATCH —W L. Long, R.F.D. No. 1, Independence, Kans. The object is to provide a pipe patch for repairing leaks in gas and water pipes. The construction combines a curved patch plate and the gasket of a clamp comprising a U-shaped yoke and a cooperating presser bar being interengaged at one end, the presser bar having an eye at its opposite end, receiving a threaded end of yoke, and a nut, holding said eye in position on the yoke.

Heating and Lighting

FURNACE.—M J Granny, 782 Lockhart St., Pittsburgh, Pa. The invention relates more particularly to hot air furnaces for burning natural or coal gases, the purpose being to provide a simple, durable and inexpensive furnace having a hot-air chamber and gas passages so associated therewith as to transmit to the chamber with the greatest degree of efficiency all the heat generated by the burning gases without the latter coming in actual contact with the air to be heated.

HEATING DEVICE FOR EVAPORATORS, PARTICULARLY EVAPORATORS FOR DRYING FRUIT —F Williams, 90 King William St., Adelaide, South Australia, Australia. The invention particularly relates to evaporators for treating and drying fruit, and it has been especially devised in order to provide devices whereby the air in the evaporator may be heated evenly and effectively without contact with the furnace gases, through sets of vertical tubes arranged in rows transversely, there being two or more rows of tubes in each set, the tubes being staggered relatively to the next row

Machines and Mechanical Devices

PLAITING MACHINE.—O. and L. B. Ossa, 1825 S. 8th St., Waco, Texas. The object is to provide a plaiting machine which efficiently folds or plaits the cloth in accordion or other desirable style of plaiting, which applies heat and an ironing pressure to the cloth during the operation and which is of simple and durable construction, reliable and easy and inexpensive to manufacture and maintain.

FRICTION TRANSMISSION MECHANISM. —H McDermott, 226 W. 4th St., Leadville, Colo. Among the objects of the invention is to provide a device in which means are provided for imparting a driving force from the drive shaft to a shaft to be driven without the use of the usual gears, chain and sprocket mechanism, or belt and pulley device. A further object is to provide for reversing the direction and varying the speed.

ICE CREAM SANDWICH MACHINE.—R. H Proper, Box 410, Gen'l P. O., New York, N Y An object is to provide a simple hand-operated utensil adapted to be plunged into a container of ice cream, carrying with it one biscuit, and so designed as to receive a film of ice cream of suitable thickness to constitute the filler between the biscuit and a second biscuit which will be applied to the face of the cream after the device is withdrawn from the container.

RACK EVAPORATOR.—F. Williams, 90 King William St., Adelaide, South Australia, Australia. The invention relates to an evaporator of the type known as rack evaporators, and it has been especially devised to provide an evaporator with which the drying processes may be completed in one building; the device has been particularly constructed for drying fruits, but may be readily adapted to treat other materials. The evaporator comprises a preparing room, sulfur chamber, a wilting room and an evaporator chamber.

ROTARY DUPLICATOR.—L P Bosc, 23 Rue Notre-Dame de Recouvrance, Paris, France This device may be applied to all kinds of rotary duplicators in which stencils are employed, it relates more particularly to an apparatus designed to effect a uniform inking of the inner surface of the cylinder and the removal of all excess of ink, returning the excess ink into the ink-box and cleaning the cylinder after the copies have been made.

PAPER-MAKING MACHINE.—L. E. Milkey, Box 251, Sandusky, Ohio. Among the objects is to provide means for removing the moisture from paper fabric while it is moving in the form of a sheet. A further object is to provide a blow roll against which paper, fabric, etc, is smoothly held between perforated aprons, strips, or conveyors, so that air of any desired temperature can be forced through or into contact with the sheet to remove the moisture therefrom. The device may also be utilized as a conveyor for chemicals for disinfecting, or liquids for coloring the sheet.

AUTOMATIC SCALE.—A. and A. T McLeod, 532 W Marquette Ave., Chicago, Ill. An object of the invention is to provide an automatic scale adapted primarily for weighing coal, but not confined to this kind of material, arranged to continuously weigh equal quantities in an intermittently running stream. A further object is to provide a starting and stopping mechanism, the co-acting parts being respectively made to operate by the coal-discharge valve and the scale beam, the two performances taking place automatically.

ROCK DRILLING MACHINE.—R. A. Krampitz, Valdez, Territory of Alaska. An im-

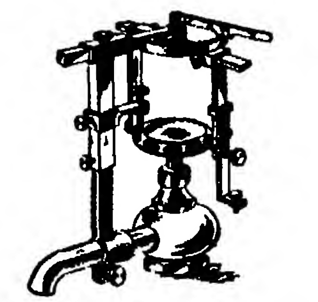


Fig. 5.—An ingenious controlling means for spring operated faucets, invented by George A Hickman.

Fig. 6.—The object of this tool is to produce an auger that does not clog with its own chips. It is the invention of A. J. Burke.

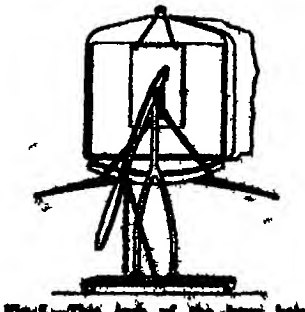


Fig. 7.—This lock, of the [illegible] [illegible] invented by [illegible] [illegible] such as the Ford.

portant object is to provide a machine in which the power may be applied direct to the drill through a positive mechanical train to impart uniform, constant and efficient operative movement. Another object is to prevent severe unusual and destructive stresses from being set up in the drill by automatically releasing the power when the drill is jammed, caught or otherwise held against its normal operative movements.

AUTOMATIC VALVE CONTROL.—T CUSHMAN, Colonial Hotel, Chillicothe, Ill. This invention relates to valve control mechanism An object is to provide a device by means of which a valve, such as that leading from a sludge-treating tank, may be operated automatically and periodically without any attention, the operation being by hydraulic means, thereby insuring the positive opening and closing of the valve.

STEAM ECONOMIZER.—J L. BARRETT, 958 So. 2nd St, Plainfield, N J The object of this invention is to provide a device of the character specified, adapted for use with steam engines and to be arranged between the boiler and the engine for conserving the exhaust from the engine and returning it to the boiler for re-use before the exhaust has lost its heat

MOTOR-BEARING-BURNING-IN STAND — H VATTER, c/o Wray-Dickinson Co, Inc., Shreveport, La. One of the principal objects of the invention is to provide a stand of the nature set forth, consisting of a hinged table for securing the cylinder block in place on the stand in such manner that the cylinder block is made accessible for inspection, assembling, removal, adjusting or fitting of parts, without removing the block from the machine.

LABELING MACHINE.—J Q LEAVITT, address Herbert L. Harrington, c/o Utah Canning Co., 29th St. and Pacific Ave, Ogden, Utah. An object of the invention is to provide means for feeding cans onto a track and for moving the track vertically, so that the cans receive first a daub of paste, then a label, and then a smoothing or pressure brush, to firmly apply the label to the can, all of said mechanism operating in unison and simultaneously the several operations taking place at different stations.

LAWN MOWER ATTACHMENT.—W J BOLL, Platteville, Wis. The invention relates to a blade-adjusting mechanism for lawn mowers, particularly those types of mowers which employ series of rotary blades, operating with a fixed blade to sever the grass. An object is to provide an adjusting mechanism which will be simple in construction and adapted for use with many mowers now on the market, and which will not greatly increase the selling price of the mower

EXTRACTING APPARATUS.—J B. JENSON, 824 McIntyre Bldg Salt Lake City, Utah An object is to provide an eduction apparatus for extracting volatile and liquid substances from solids and more particularly oil from oil shale and sand, or the like Another object is to provide an apparatus whereby practical recovery may be accomplished, the apparatus being formed in sections or independent units, connected in series, so that the size and capacity can be easily varied

Medical Devices

STRINGED INSTRUMENT.—W A. VINSON, 619 No Calvert St Baltimore, Md The invention has for its object to provide a string instrument by means of which a large variety of sounds and of musical tones may be produced, and which may be operated in a variety of ways. A further object is to produce an instrument wherein the tension of the string may be constantly varied to produce sliding tones, commonly called jazz.

BED PAN.—E D ABRAHAM, 2859 W Madison St., Chicago, Ill Among the objects of the invention is to provide a bed pan having a removable waterproof lining which may be burned, thus making the pan more sanitary A further object is to provide an inexpensive lining which is convenient to handle and which will render the washing of the pan unnecessary

Musical Devices

MODULATING DEVICE FOR SOUND REPRODUCERS.—G. S PEASE, Colonia, Wis This invention relates to phonographs and similar sound-reproducing machines, its object is to provide a modulating device for sound reproducers, arranged to enable an operator to vary the vibratory action of the diaphragm at will. Another object is to permit of conveniently attaching the modulator to sound reproducers as now generally constructed.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—E. L. MALMBARY Fairfax, Calif. An object is to provide an engine of the two-cylinder type which is scavenged as completely as an engine of the four-cylinder type A further object is to provide a device in which the explosive charge is forced through the hottest part of the motor, thereby not only rendering the fuel more easily ignited and consumed, but also tending to cool the engine

SPARKING PLUG WITH SELF CLEANING ELECTRODES —H SCHREER, La Garrenne Colombes, Seine 28 Boulevard National, France. The invention relates to sparking plugs used for the ignition in internal combustion motors, it is more particularly characterised by the fact that one of the electrodes is movable or that both electrodes are movable relatively to each other The arrangement has for its object to perform a self-cleaning of the parts upon which the spark takes place, thus favoring the operation of the motor

POWER PLANT —O K BOOSTRAND, 4810 6th Ave., Brooklyn, N Y This invention relates to internal combustion engines, and has in view to furnish a combustible fuel at reduced cost, to conserve the heat units employed in the production of said fuel to vary the quantity of fuel during the period of employment thereof and to employ the surplus heat incident to the formation of said fuel for various purposes.

Railways and Their Accessories

RAILWAY CAR WHEELS AND AXLE —T LITTLEFIELD, Exira, Iowa The purpose of the invention is the provision of a special form of car wheels and means for supporting them on an axle, whereby the wheels can rotate together when traversing a straight stretch of tract and independently of each other when traversing a curved stretch, thus allowing the rotation of the wheels at different speeds when rounding curves and thereby preventing the uneven wear of track rails.

SAFETY ATTACHMENT FOR AUTOMATIC TRAIN STOPS —M B. BULLA, 209 Caples Bldg, El Paso, Texas. Among the objects of this invention is to provide automatic train control mechanism, including a normally closed circuit, the breaking of any part of which will insure the stopping of the train A further object is to provide electric controlled means whereby the engineer under orders may pass a danger point.

RAILWAY TRUCK —S B BRILHART, 214 W 127th St, New York, N Y Among the objects of the invention is to provide for a jointed car or structure of supporting trucks with operative connections between truck portions, which serve to control the alinement of the several truck portions with the rails under all service conditions, there being provided rod and lever connections, whereby the swinging of either main truck, due to its taking a curve, will cause a certain swinging movement of the center truck.

Pertaining to Recreation

GAME APPARATUS —A O COLLIARD, 73 Pine St., Milford, Mass. This invention relates to a game apparatus in which the operator endeavors to assemble certain eccentrically movable members within a fixed space on a field. An object is to provide a game which will prove interesting and amusing, at the same time will require great skill on the part of the operator

BATHING BOAT.—J SERETO, 553 6th Ave., Brooklyn, N Y The general object of the invention is to provide a structure adapted to afford amusement as well as exercise. The structure includes a hull composed of airtight compartments having a well extending therethrough and a seat to accommodate the user a paddle wheel in the front of the well, and levers with hand-holds for actuating the paddle, and a rudder adapted to be operated by elbow pressure

AMUSEMENT APPARATUS.—F W. THOMPSON, Dec'd, address Mrs. Selene P Thompson, administratrix, 350 W 55th St, New York, N Y The object of this invention is to provide an amusement apparatus for use in pleasure resorts, exhibitions fairs and other places, and arranged to accommodate a number of passengers at a time and to give the passengers the illusion of a trip in an aeroplane another object is to render the apparatus portable from one place to another, and to allow of setting the same up in a tent or other structure

MECHANICAL TOY —P A. MARSHALL, 3501 Paloma St., Los Angeles, Cal. The invention has for its object to provide a toy wherein there is provided a rotatable support carrying a series of representations of airplanes, so connected with the support that they may move upwardly and downwardly with respect thereto, the downward movement of the one controlling the upward movement of the other and also controlling the rotation of the support.

Pertaining to Vehicles

JACK.—T A LAKE, Hillman Mich The invention relates to a jack of the lever hoist type. An object is to provide a lifting device which is especially adapted for use with the ordinary Ford type of automobile which can be used to raise the forward end of the body of this type of car take the weight off the springs and allow the springs themselves or the truss rods connected with them to be removed and replaced (See Fig 7)

BICYCLE PROPULSION GEARING —G H W DOOSS, 311 Olivia St Algiers, La The invention particularly relates to that type of gearing wherein multiplying gears are interposed between the sprocket-wheel on the crank shaft, and that on the rear wheel for the purpose of speeding up or driving the propelling wheel at a higher speed than the crank shaft The object is to provide a device wherein a high speed and increased power are attained without the necessity of rapid pedaling

CRATE.—M. R MOFFITT, Peck Kans. The object of the invention is to provide a crate especially adapted for use with motor vehicles, and to be arranged upon the running board of the vehicle, and having means for clamping the same The crate is composed of detachable sections permitting it to be quickly assembled for use or disassembled for storage

DIRECTION-INDICATING SIGNAL FOR AUTOMOBILES —A E BELLER, 508 31st St Ogden, Utah This invention has for its object the provision of a manually operable signal of simple durable and efficient construction, which is attachable to the cowl of an automobile, so that the operator can readily manipulate the indicating arm to signal the direction in which the vehicle is about to turn

VEHICLE WHEEL.—A B FEHR, City Court of Macomb, Macomb Ill. An object of this invention is to provide a wheel for automobiles and other vehicles which contains in itself spring means interposed between the rim and the spokes, spaced at equal distances apart, thereby effecting a multiplied resilience at the rim relative to the resilience given out by the springs employed

DIRIGIBLE HEADLIGHT —G F MESSER 304½ E Heron St, Aberdeen, Wash Among the objects of the invention is to provide a headlight which will automatically swing the lights horizontally with the front wheels of the vehicle to maintain the light beams parallel with the plane of the front wheels and which may be manually operated to swing the lights vertically The device is adapted to be associated with various types of motor vehicles.

AUTOMOBILE BODY AND TOP THEREFOR.—C T SILVER 100 W 57th St New York, N Y This invention has for its object to provide an automobile body having an opening for receiving the top when it is lowered means being provided for closing the opening after the top has been raised or lowered to the desired position Another object is to provide a top which will fold to permit of the stowing in the opening in the body of the machine

STEERING WHEEL LOCK —G A WERNER 420 Habersham St Savannah, Ga. The primary object of the invention is to provide a simple inexpensive mechanism carried by a cap engageable with and disengageable from the gear housing of the steering post whereby the steering wheel may be latched in its active position in a readily releasable manner and locked in its raised or elevated position where it is inactive.

WORK AND DISPLAY STAND —I H and J H GARTNER, address John H Gartner Lava Hot Springs, Idaho. This invention relates to a stand which is capable of grasping and retaining any type of automotive vehicle and by means of which the vehicle may be moved readily to a position in which its under side will be easily accessible for repairing or display purposes, and which is so simple in construction and operation as to be capable of being manufactured at a low price

WHEEL.—H D REY Rey Wheel Co, 318 Park Bldg Detroit, Mich The object of the invention is to provide a wheel adapted for use in any connection, composed of a hub a rim and a spoke portion, which consists of two sections, formed from sheet steel, pressed or stamped to shape and adapted to be fitted on the hub and to engage the rim, and to cross each other between the hub and the rim, and to be pressed together to engage the hub and rim and support the hub from the rim.

WHEEL-CHAIN TIGHTENING TOOL —Z A LAVOIE address J E. Lachance Manchester, N H The invention relates to tools adapted for use in the tightening and adjusting of wheel chains of the Weed type so that they can be properly fitted to the tire A purpose is to provide a tool which is extremely simple in construction yet is effective in its work of tightening the chain

VARIABLE SPEED POWER TRANSMISSION —O S PULLIAM Room 2528 Park Row Bldg New York N Y The primary object of the invention is to provide a driving mechanism particularly adapted for use in self-propelled vehicles a further object is to provide a device which will not only replace the differential mechanism commonly employed but is also capable of providing for a change of driving speeds thus eliminating the necessity of the transmission mechanism usually employed A still further object is to so construct the device that a wide range of speeds may be obtained

HAND WHEEL —H W DOVER Holywood St James, Northampton England This invention relates to hand wheels such as are employed for steering motor vehicles, controlling aircraft motor boats gun mechanism, and for other purposes, and has for its object to obviate or reduce the use of cast parts. The hub is formed with a groove adapted to receive the inner ends of the spokes, said groove being bounded on two of its sides by flanges, adapted to be pressed toward one another so as to fit closely around the spokes.

TRACTOR WHEEL —E. H WHITING R.F.D No 3 Box 501, Santa Rosa Calif One of the principal objects is to provide a tractor wheel with means for automatically cleaning the same upon each revolution The invention further contemplates a wheel having tractor elements which are capable of radial projection from the tread and means for projecting such elements at their point of contact with the ground said means also serving to retract the elements to permit a scraper to co-act with the tread for clearing the same of earth adhering thereto.

Designs

DESIGN FOR A JAR —J M. LUCHESSA, Cambria Calif

DESIGN FOR A COMBINATION CHECKER BOARD AND TRAY —A M DEIO, 522 Jefferson St Seattle Wash

DESIGN FOR A RULE HOLDER —T D FREDERICK 330 Connecticut St San Francisco Calif

DESIGN FOR A SIFTER TOP RECEPTACLE —M. WOLF, 1186 Tinton Ave, Bronx, N Y

DESIGN FOR A SPOON HANDLE —T A. WILLIAMS Battle Ground Wash

DESIGN FOR A COVER.—S GEISMAN c/o Geisman Musker & Brightman 27 Spruce St, New York, N Y

DESIGN FOR A POWDER CONTAINER.—C S HUMPHREY, Bush Terminal Bldg No 10, Brooklyn N Y

DESIGN FOR AN ELEVATOR SIGNAL — P S VAN BLOEM, The Viking Sign Co, 617 8th Ave New York N Y The inventor has been granted patents of three designs of a similar nature

Our Readers' Point of View

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Transparency of Moving Automobile Wheels

To the Editor of the SCIENTIFIC AMERICAN:

Some time ago a reader of the SCIENTIFIC AMERICAN asked why the upper part of a moving automobile wheel appears more transparent than the lower part. The question was answered in the SCIENTIFIC AMERICAN for January 22, 1916, p 113 answer 14026, and was further discussed by Mr Albert J Dow in the SCIENTIFIC AMERICAN SUPPLEMENT for April 1 1916, p 215. G W C., who asked the question, stated that photographs of automobiles going at fifty or sixty miles an hour sometimes show the lower part of a wheel clearly but give the impression that the upper part of the wheel is transparent. Mr Dow also speaks of the "commonly noticed phenomenon that the top of the wheel is the most transparent.' The explanation given by the Editor of the SCIENTIFIC AMERICAN and amplified by Mr Dow is that the upper part of the wheel is moving faster than the lower and therefore that a spoke in the upper part of the wheel passes an object more quickly than a spoke in the lower part of the wheel.

For some time I have been trying to observe this effect, and I must confess that I do not see it. The top of a wheel looks no more transparent to me than the bottom. Is there something the matter with me, or is there something the matter with the explanation that has been given? I think the trouble is with the explanation

The upper part of a wheel does, of course go faster than the lower part. But not only does a spoke near the top of a wheel move across an object more quickly but so does the *space between spokes*, so that on the whole an object behind the wheel is obscured by spokes for about the same fraction of the time whether it is behind the upper part or the lower part of the wheel.

To see how the width of a spoke affects the result consider the point A in the figure. Let a stand for the radius of the wheel, r for the distance from the middle of the axle to the point A b for the width of a spoke, θ for the angle which the spoke makes with the vertical, $\dot{\theta}$ for the angular velocity of the spoke with reference to the car and V for the linear velocity of the car Then the velocity of A with respect to the ground is the resultant of the horizontal velocity V of the car and the velocity $\dot{\theta}r$, with which the point A is moving with respect to the car But $V = \dot{\theta}a$, so that the horizontal component of the velocity of A is

$$\dot{\theta}a + \dot{\theta}r \cos\theta$$

Now a horizontal section of the spoke has a width $b/\cos\theta$, so that the time during which a point behind the wheel is shut out from view by the spoke is

$$\frac{\text{horizontal width of spoke}}{\text{horizontal velocity of spoke}} = \frac{b}{\dot{\theta}\cos\theta\,(a + r\cos\theta)}$$

Similarly if e represents, at the distance r from the axis, the clear distance between one spoke and the next, the time during which a point behind the wheel can be seen between two consecutive spokes is very nearly

$$\frac{e}{\dot{\theta}\cos\theta\,(a + r\cos\theta)}.$$

On dividing expression (1) by expression (2) we find that the ratio of the time during which a point cannot be seen to the time during which it can be seen is approximately b/e This ratio does not depend on whether the object observed is behind the upper part of the wheel or the lower part, but it does depend on the distance from the axis. The wheel should therefore appear more transparent near the rim and less so near the hub. And that is the way it looks to me.

Now what about the photographs which showed the lower part of the wheel clearly and the upper part not clearly? These photographs were, of course taken with short exposures, and during the time of exposure the lower part of the wheel had moved only a little and the upper part had moved farther That is, the explanation that was given by the Editor of the SCIENTIFIC AMERICAN does apply to the photographs. If we could make a sufficiently short and sufficiently intense exposure on the retina we ought to be able to see the lower part of the wheel more clear and the upper part more transparent. I have attempted to get this effect by closing my eyes when a car was approaching, and then quickly opening and closing them again while looking toward a wheel. But I am not usually successful in seeing the effect that G J C. says the photographs show One reason for the failure of the eyes to observe this effect seems to be that when the eyes are exposed for so short a time details cease to be visible. A second reason is to be found in the tendency of the eyes to follow the car in which case the effect will, of course, not appear A third reason, I think is the smallness of the space that can be clearly seen at one time. Thus on quickly opening and closing my eyes when I have happened to be looking toward the upper part of a wheel I have sometimes seen—or at any rate have thought that I have seen—the upper spokes more clearly than the lower

ARTHUR TABOR JONES.

Smith College

Peculiar Action of Rotating Cardboard Discs in Air

To the Editor of the SCIENTIFIC AMERICAN:

As a subscriber to your journal in a remote corner of the world, I have read with interest an article therein some few months ago relating to the action of currents of compressed air on balls and discs. The experiment particularly in mind is one in which by blowing through a tube, with a disc-like flange on one end, upon another disc of cardboard, the latter instead of being blown away as one would expect, approaches the flange end of the tube from which the air current is issuing, with considerable attractive force.

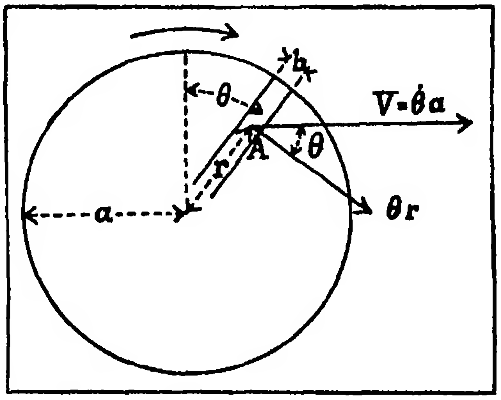
After performing the experiment satisfactorily for my amusement, I attempted to investigate the action of air on moving discs, the crude results of which may be of interest to your readers.

Having mounted a cardboard disc eight inches in diameter upon the spindle of a small electric motor running about 3,000 R.P.M., rotating the disc in its own plane above its axis, tests were made upon both sides of same, for signs of vacuum effect, by means of strips of paper held more or less closely to the rotating disc. Considerable attractive force was found, strongest towards center of disc, and equal on both sides, the attractive force coming into play fairly abruptly about one-eighth inch from surface of disc, which seemed to point to something more than air currents produced by the centrifugal action of the rotating disc. Again, upon presenting a larger cardboard disc 12 inches in diameter, held parallel to the plane of the rotating one, and approached to a position about one-eighth inch from same, a strong attractive pull was obtained, registering about one-quarter pound. It occurred to me that if the attractive force upon one side of the disc could be neutralised, and the corresponding force upon the other side be allowed independent action a new lifting or propelling means for airships might be evolved. My experiments in this direction were too crude for satisfactory results.

Another experiment made with a number of discs mounted loosely on the motor spindle, free to approach or retire from one another showed that these discs rotating in a medium such as air immediately and strongly attracted one another always tending to form one disc. If revolving discs in air will gravitate, as it were, to one another, why should not revolving atoms in the ether do likewise?

CHARLES JOHNSON

Hobart, Tasmania.



Energy from Waste Water

To the Editor of the SCIENTIFIC AMERICAN

In your issue of May 7th 1921, is an article entitled "Electric Light From Waste Pipe Flow" being a quotation from an article presented by M. E. Colardeau at a meeting at the Academy of Sciences, at which he is reported to have made a statement to the effect that many millions could be saved yearly by the utilization of the energy from tap water in houses.

He makes the statement: "If the water flows, as is usual from a cistern five meters above and at the rate of one liter per second, this flow provides sufficient power to keep charged accumulators necessary for the lighting of 20 lamps of 10 to 50 candle power each."

The problem of investigating the possibility of obtaining energy from the water supply of a household may be taken up in four ways:

1 A checking up of a statement of M. Colardeau, using the factors of a fall of five meters and the rate of use of one liter per second, and as a part of the answer find what one liter per second means in consumption per capita.

2 By a computation of the amount of energy obtainable from the amount of water ordinarily consumed by an American household at an ordinary pressure at which the water is supplied.

3. By a computation of the amount of water required at an ordinary pressure to supply the electric current used by an ordinary American household and as a part of the answer find the effect on the water supply system of a community by any such requirement.

4 A comparative estimate of the cost of the electric energy obtained as in 3 with the cost of electricity obtained from a central power station. I will give the solution of the problems in the order presented.

1 One liter per second is equivalent to 61 023 cubic inches divided by 231 equals .264 gallons per second or 22,810 gallons per 24 hours. In a family of four this would mean a daily consumption of water of 5,702 gallons per person against an ordinary consumption of 100 gallons per person, which is considered an ample supply It will be readily seen that the use of any such volume of water as called for by the first problem requiring 57 times as much water as is ordinarily consumed would mean an immense enlargement of existing systems of water supply if this plan of obtaining electric energy should be universally adopted.

2. The amount of water consumed per capita per day in an American family is frequently taken as 100 gallons, while my personal observation and measurements indicate that 50 gallons are amply sufficient where there is no allowance for leakage in mains, but for this problem let us assume the use of the larger amount. In a family of four this would mean a daily requirement of 400 gallons. Say this could be delivered at a pressure of 60 pounds to the square inch and that the full measure is available.

If the water could all be drawn in one hour we would have a use of 400 gallons ÷ 7.48 = 53.5 cubic feet per hour equivalent to .015 cubic feet per second. Sixty pounds' pressure is equivalent to a head of 138 feet. With a water motor of 75 per cent efficiency the power of this water at this head will amount to .015 x138x.085=.176 horsepower for one hour, equivalent to .132 kilowatt hours or enough power to light 3.3 forty watt lamps for one hour, making no allowance for losses in electric generator, wiring or storage batteries. What American family would be satisfied to use but three forty watt lights for one hour, or even one such light for three hours, on a Winter's evening?

3. I am informed by central station operators that the ordinary consumption of electricity by an American family of four in the Winter months is approximately one kilowatt hour per day. This is equivalent to 1-1/3 horsepower hours and if as before we assume that water is delivered at a pressure of sixty pounds per square inch, equivalent to a head of 138 feet, with no losses by friction, this 1-1/3 horsepower hours would require .113 cubic feet per second of water equivalent to .845 gallons per second or for the one hour 3 042 gallons, or at the rate in a family of four of 760 gallons per day, a requirement for this purpose of 7.6 times the amount of water ordinarily allowed per person in an American family or about 15 times the amount of water necessary to meet their requirements.

Again this water could not all be drawn in one hour and the charging of storage batteries would be done spasmodically as the water was drawn. Again there would be losses of efficiency in the generator, storage batteries and wiring so that the probable requirement of water to furnish the one kilowatt hour would be at least double the above amount, coming to 1 500 gallons or more per person a day

4 Let us see what the consumption would cost us in order to obtain one kilowatt hour called for by the statement in 3. Assume as in problem three that the requirement for a family of four is one kilowatt hour, requiring about 3,000 gallons per day for its manufacture, making no allowances for losses of efficiency in generator, storage batteries and wiring In the City of Lewiston, Maine, where water is furnished at probably as low a rate as any city in the United States where pumping is resorted to, water is sold at the rate of twelve cents per 1 000 gallons.

Our 3 000 gallons a day then will cost thirty-six cents, whereas in this city one kilowatt hour of electricity for lighting is sold at eight cents per kilowatt hour, so that by this method of obtaining electric power the cost per kilowatt hour will be over four times that at which the same can be purchased from the central station, making no allowances for losses in generator, storage batteries or wiring and if we include charge of interest and depreciation on the cost of equipment a kilowatt hour will probably cost about eight times the amount at which we can purchase the same here.

The conclusion drawn from any of the answers to the above problems is that what little energy there may be in tap water will continue to be lost.

WALTER H SAWYER.

Lewiston, Me.

Did Stone Dust Kill the Cliff Dwellers?

To the Editor of the SCIENTIFIC AMERICAN:

Some time ago you printed an article under the above title or at least on the above topic, which I read with extreme interest. Living as I do in the land of the Cliff Dwellers and about twenty miles from the Aztec ruins, I have been interested in the subject for years.

Those who have observed Indians at their work and who have noticed the deliberate leisurely way they go about it, can hardly agree with Mr. Hoffman's theory

Making arrowheads and other articles which they used could hardly have caused dust enough to do harm, and while there is a great accumulation of dust in the ruins at the present day, it is likely that when they were occupied the floors were kept damp by sprinkling, as the earthen floors in Mexican houses are kept moist today

In concluding his article, Mr Hoffman touches upon what I think was the real reason of the disappearance of the Cliff Dwellers, namely starvation.

We know that they were an agricultural people and farmed the mesas of the region, but what farming it must have been! They kept no domestic animals; if there had been any on the continent then, it would have been impossible to keep them in the cliff houses and they could not have been left below a prey of those who at times attacked them. Imagine farmers of today putting in their crops with no beasts to pull tillage implements. With no tools of metal of any kind whatever. Imagine farmers dropping a few kernels of corn on the ground and punching them in with a flint-topped stick, as the Pueblo Indians were doing up until a few years ago. Imagine the farmer cultivating the crop with a hoe made of the shoulder-blade of a deer, tied to a stick with thongs.

How long could we grow crops in this fashion? Possibly they selected their seed much as the Mexican "ranchero" selected his bulls; leaving every seventh male calf entire regardless of "race, color, or previous condition of servitude."

The ancient dwellers in the ruins at Aztec had a large canal which evidently was used for irrigation, but the land under it, until the whites grew alfalfa and manured it, was about the hardest prospect that man ever undertook to farm. Now it will raise anything that will grow in this climate. The former owners simply farmed themselves out of a job, first depleting the land nearest them, then farther and farther out. Perhaps these out posts became difficult to hold as their numbers were reduced and a year or two of crop failure would end the story; a good deal simpler than dust-induced tuberculosis.

[illegible]

Durango, Col.

Mechanical Engineering Notes

Survey of Progress in the Mechanical Arts Gathered from Various Sources

The Schoop Process has been steadily developed abroad, and one begins to wonder why we have not paid more attention to this ingenious system of spraying metals. The Schoop pistol is now being used even for galvanizing various outdoor equipment, while its uses for coating objects with copper and other metals have steadily increased.

Rivet-Cutting Gun Abroad—The rivet-cutting gun, which has been in use in this country for some length of time, has recently made its debut in Europe This device is a great time saver A cold rivet 1½ inches in diameter may be cut in 30 seconds. ¾ inch rivet may be cut with three or four strokes of the gun. Indeed, with this tool, three men in nine hours' time, can cut more than 3 000 rivets.

Expediting Marks—One blow of the hammer on one of the new holders of steel stamps does what it would require several operations to do with individual stamps. This is the speedy, accurate, labor-saving way to do interchangeable marking with less effort on all metal products. No matter whether one is doing light marking such as numbering plates and small parts or analysis and heat code on hot billets and slabs, there is a holder available for the work.

Rapid Cleaning of Aluminum—There has recently been introduced a new material for the cleaning of aluminum parts The old method of removing polishing oil and emery consisted of hand brushing the parts with high grade gasoline that cost 35 cents per gallon The present method is not to do any hand brushing, but to wash the parts in a solution which costs only two cents a gallon. Fire risk is eliminated work comes through in perfect shape and a marked economy is effected in the cost of materials and labor

A Severe Vise Test—An American manufacturer of vises has an interesting and quite convincing test to demonstrate the accuracy of his products. He claims that his vises are so carefully machined and assembled that when two steel balls of equal size are placed in the vise the minimum compression required to hold one ball will be just enough to hold the other This is true of practically all vises made by this manufacturer, and for this reason his vises hold the work firmly and tightly with less pressure and with less strain on the jaws and screw Workmen will exert less effort in setting and releasing such vises, it goes almost without saying

Reversing Gears for Locomotives is one of the recent refinements which are steadily gaining ground To anyone it must be obvious that the reversing of a powerful locomotive by the manual method must be a strenuous task, especially when it has to be repeated many times in the course of even so short an interval as an hour This is often the case in switching and yard work, and the tiring of the engine crew accounts for a considerable loss of time, especially over a period of many hours The reversing gear is a steam-operated device which operates the reverse gear by the mere manipulation of a valve Thus the engine may be instantly reversed with virtually no physical effort, and much time is saved in consequence

Speedings of Grinding Wheels—In general, a soft grinding wheel revolving rapidly permits a higher production than a hard wheel revolving more slowly states a recent issue of *Grits and Grinds* This is true because the more open structure of the soft wheels provides greater clearance for the grinding chips, which results in a freer and cooler cutting action Theoretically therefore the correct speed for grinding wheels is the safe maximum speed at which the wheel may be operated In actual practice, however, certain ranges of peripheral speed may be found to give good results on certain classes of work For example, a satisfactory wheel speed for sharpening wood-planer knives is around 5 500 surface feet per minute for cylindrical grinding of crankshaft pins and bearings, around 6000 surface feet per minute and for cutting off hardened and high-speed steel tubing and the like the proper speed approximates 9 000 to 10 000 surface feet per minute The following conclusions are reached regarding grinding operations:

1 The grade of hardness to be recommended for a grinding operation depends on the surface speed of the wheel. 2. The grinding wheel should be as soft as is feasible for the operation, and whenever possible operated at the high end of the recommended range of speeds 3 For a given wheel used for precision grinding operations, not much increase in production is to be expected from increasing the speed of the wheel alone. 4 The logical way to increase production in precision grinding operations is to increase the traverse of the work past the wheel or the depth of cut of the wheel.

The Maag System of Gear Cutting, developed in Switzerland, is attracting no little attention in Europe. The wheel blank in the Maag machine is mounted on a vertical axis. The movement of the cross-slide during the generating movement is effected by an auxiliary screw, which keeps the slide in uniform contact with the flank of the main pitch screw It is claimed that this system eliminates all play and backlash. On the Maag system the wheels can be formed of a mild or nickel steel and case-hardened and ground after being cut. In conjunction with the Maag gear cutter there has been developed a generating grinding machine which presents some novel features. The wheel to be ground is mounted on a longitudinal axis and is fed in that direction beneath two saucer-shaped grinding wheels inclined at the same angle as the teeth of the rack cutter. By an ingenious mechanism combining a reciprocating and a rocking motion the wheel as it passes beneath the grinding wheels receives the same rack and pinion action as in the cutting machine. An electrical device is fitted to compensate for the wear of the grinding wheels.

Zinc for Automobile Bodies—Zinc sheets are now being used for many automobile parts. In the No 18 gage and the heavier ones employed the metal possesses all the strength required, while the cost is decidedly less than that of aluminum. It has the further recommendation that it does not rust and cause the enamel to chip off In supplying large quantities of zinc for making hub caps and other parts of automobiles, an American zinc company realized the need of a joint different from the soldered type, which would possess as much, or more, strength than the metal and which could be polished smooth without losing any of its strength The company in question was thus led to successful experiments in zinc welding The edges of two sheets of zinc were cleaned bright and butt-welded, with a strip of the same material to fill in and give strength to the surface Bending and tensile strength tests of the joint after it had been polished smooth showed that the two sheets were completely united, and that when thus joined together they were fully as strong at the point as at any other place The work was done with the oxy-hydrogen flame of a lead-burner's outfit by two men who, it is stated, were not especially expert either in soldering or in lead-burning

The Odontometer and the Testing of Gear Teeth—It has remained for a well-known American tool-making concern to develop a practical instrument known as the odontometer for the testing of gear teeth This device is equally adaptable to spur and helical gears, is fully self-contained, has a range of from 3 to 10 diametral pitch, may be used to check any pressure angle and can be applied to a gear while it is in place in the machine. An instrument of larger size is now under way for testing the teeth of gears ranging from ¾ to 4 diametral pitch. The odontometer, as used to test spur gears, is composed of a section of a straight-sided rack with two parallel effective faces, one being fixed and the other movable A third face, set at an angle to the two working faces, is used to hold the fixed working face in contact with the flank of the gear tooth A registering member is included, which gives direct readings In general, the instrument is used as a comparator, to test the uniformity of interchangeable and mating gears. If actual measurements are required, the distance between the two parallel working faces of the instrument can be measured. Then, if a record is kept of the variation on each tooth, the value of this measurement between the parallel faces, multiplied by the number of teeth in the gear, corrected in accordance with the variations on the successive teeth, will give the circumference of the actual base circle of the involutes

Standardized Machine Parts—An important saving can be effected in machine shop practice by extending the standardization of machine tool parts If it were possible, for example, for lathe manufacturers to agree upon certain standards for toolposts face plates, spindle noses, and other parts, this standardization would result in considerable economies in all shops where machine tools are used. It would be comparatively easy to arrive at some common standard for T-slots for machines of similar type and size, continues *Machinery* Another important extension of standardization concerns the motor builder rather than the machine tool builder Motor manufacturers have not as yet been able to agree upon such standard dimensions for electric motors as will enable the manufacturer to place any make of motor of a given size and for a given current on his machine, without special provision for it. The motor manufacturers have made great progress in standardizing the electrical details, but apparently they do not yet fully appreciate the value of what may be called "mechanical standardization." By cooperation the motor manufacturers could agree upon certain frame designs that would place the shaft for the pulley at a given height above the support. The location of bolt holes should also be uniform, and the shaft diameter should be standardization so that the same pulley will fit on any motor of the same size and for the same current, irrespective of the make.

Miscellaneous Notes

School for Hotel Men.—Belgium will establish a National School of Hotel Management in Brussels. The school takes the form of a model hotel.

U. S. Grant Centenary Coins. It is proposed that 200 000 gold dollars be coined to celebrate the centenary, this coming April, of Grant's birth.

Essen Turns to War Material. Through Berlin we learn that Krupp's is resuming the manufacture of munitions and that Machine Section No. 2 has three howitzers under construction.

Thunder Restores Speech.—When a thunder storm shook the ship on which he was traveling, C. Lavier, a veteran dumb for nine months from shell shock, found he could talk.

The "Truth-in-Fabric" Bill.—Retail clothiers and wool growers are backing the French-Capper bill providing for the marking of wool-content on goods. The unrestricted use of shoddy is materially affecting the sheep-growing industry.

Our Trade in India.—Recent experiments in selling American goods in India seem to indicate that, contrary to popular belief, quality, delivery and superior design often win over low prices, especially in industrial machinery and equipment.

The Dover Patrol Memorial on the Dover cliffs is an obelisk 84 feet high, tapering from a base 21 feet square, and built of 700 tons of Norwegian granite. It has a duplicate across the Channel near Calais.

Japan Reassures Our Candy Makers.—The manager of the Morinaga Confectionery Company, Tokio, brands as ridiculous the report that the American candy market is to be flooded by Japan. He says that sugar costs them about 6 cents a pound, and that the ocean freight rates make export to America impossible.

"One-Age" Companies at Plattsburg. At the Citizens' Military Training Camp a new plan groups the rookies by age instead of by their home towns; this will yield light upon what age most quickly produces the trained soldier and which shows the greatest physical improvement in a given time. The plan may have far-reaching effects.

Films of the Western Front.—England's Imperial War Museum has more than 600 separate films covering all aspects of the war on the western front and about every event in the war life of a soldier. A small exhibition room and storage vaults in the War Office are given over to these films, and all are to be carefully inspected to determine which are worthy of permanent preservation.

An Ingenious Fraud.—A Paris mail order dealer objected to the raise in postal rates, so in sending out stamped envelopes for reply, he covered the stamps with a thin layer of mucilage. When these came back he sponged off the cancellation mark and used the stamps over again. Unfortunately for him, postal detectives discovered the ruse and he was fined 2 000 francs after successfully working the scheme in more than 10 000 instances.

Our Niagara of News. From the presses of the United States flow eleven and a quarter billion copies of daily newspapers annually. Census statistics show that in 1919 we had 2 433 dailies that together issued 32 735 937 copies a day, a 13.8 per cent increase over 1914, while our 592 Sunday papers showed a 14.9 per cent increase. All products of the printing and publishing industry in 1919 are valued at $1 528 256 508; toward this total newspapers contribute $612 718 515.

Where the Jinrickshaw Came From.—The jinrickshaw is a part of our mental picture of Japan. It seems to fit in with the age and queerness of this picturesque land. Yet a Philadelphia preacher invented this horseless carriage less than a hundred years ago, and the wheeled chairs of Atlantic City are much older. The clergyman reached Japan with Commodore Perry's fleet and was asked by the Mikado to suggest some vehicle fitted for use in the imperial parks. That is the authentic story of the birth of the jinrickshaw, and the name is a combination of three Japanese words which, literally translated, mean man-power-cart.

Helium and the Dirigible Disaster.—Wherever the initial blame may be placed for the loss of the ZR-2, one error should not be repeated, that is the use of hydrogen gas as a filler. Some time ago we were turning out helium at 10 cents a cubic foot; at the time of the Armistice we were building plants to produce 50 000 cubic feet a day, a huge stride toward safety in ballooning. The preservation of lives valuable to their country, to say nothing of the common sense of safeguarding a two-million-dollar piece of property, should urge the resurgence of our helium plants and the lowering of the cost of this non-inflammable gas as fast as science can accomplish it.

Revolutionary Mail Machine.—There is now in use in New York a machine that, instead of using glued stamps, prints an equivalent postal notice on envelopes at the rate of 250 a minute, thus saving an enormous amount of time and preventing loss of stamps by theft. The machine was perfected after 14 years of experimentation and Congress has authorized its use. An additional device, which may be operated separately, seals the letters; both may be worked simultaneously by a one-fourth horsepower motor attached to a common light socket. The lessee carries his dialed meter to the post office, where it is set for the amount of postage desired and the money paid in advance. Both the business office and the post office benefit largely. Applications may be made through local offices for the necessary permits from Washington.

Electrical Notes

Summaries and Excerpts from Current Periodicals

Swordfish Hunted With Electricity.—Electrocution is now the approved mode of landing the swordfish off No Man's Land, Mass. A seventy-five-pound specimen was recently taken by sending an electric current through the steel harpoon

Osiris Prize Award.—Gen Ferrie, C.M.G has received the Osiris prize of 100 000 francs in recognition of his war services. He initiated the whole radio organization equipped the Eiffel Tower station and did much to bring the thermionic valve into practical use.

Farm Lighting Sets for Britain.—A little judicious publicity work should make England a good market for our farm lighting sets; she has now but a thousand of these equipments many of them obsolete Of course the conservatism of the farmers is the stumbling-block

California's Hydroelectric System.—Stone and Webster Inc recently exhibited at Boston a moving picture illustrating their hydroelectric installment in the Cascade Mountains The impulse wheels the largest in existence each generate 30 000 horsepower This plant saves the State a million gallons of fuel a year

New X-Ray Plate.—A plate reducing exposure to one-twenty fifth especially applicable to radio-metallurgy has been produced in England. High sensitiveness is obtained by incorporating the intensifying screen with the plate After exposure the screen is dissolved off and development carried out for somewhat longer than usual

Berlin and the Trackless Trolley Idea.—The high cost of track laying and electrical equipment has given the trackless trolley a favorable hearing in Germany as well as elsewhere. We learn from a recent dispatch that Berlin is about to try the trackless trolley as a possible solution for financing the street railways of that metropolis. Another Berlin plan is to use one-man trolley cars in the suburbs just as is being done here in America in order to reduce operating costs

Electroculture Formulae.—In electroculture a series of parallel high potential wires are placed horizontally above the crop The number of wires being limited it is a question how far uniform may be the electric force at the ground level Dr Chree has evolved simple practical formulae showing how the potential gradient at the surface of zero potential depends on the height and spacing of the wires This will make it possible to secure a uniform set of conditions from which more accurate conclusions can be deduced

Trenton's New Sign The municipal electric sign Trenton Makes the World Takes located on the bridge over the Delaware River Trenton N J is again being illuminated after being dark for a number of months The Chamber of Commerce has secured subscriptions from local manufacturers and business interests to insure continuous operation for some time to come The sign is said to be one of the largest electric displays of its kind in the world being 450 feet long with letters 12 feet high and containing about 2 000 electric lamps.

A British World-Wide Radio System has been started so we learn from a London dispatch The first link has been completed at Leafield Oxfordshire for communication with stations at Cairo in East Africa and in South Africa Another branch of this service will extend to India, Singapore Australia and Hongkong It is reported that the scheme also contemplates a newspaper service to New York. The Dominion Premiers are heartily in favor of the new plan which is to bind the British Empire together with an invisible yet unbreakable chain of communication

A New Railroad Development, which is apparently electrical in nature, is reported from England. The London and North Western Railway are experimenting with a new type of engine which is claimed to be far in advance of the present steam type An electric turbine will take the place of the present motive power so states the telegram This, we presume means that the engine is to include a steam-electric turbine outfit, the current of which is to be applied to a series of driving motors. In addition to attaining a much higher velocity it is stated that the running cost will be considerably reduced

Prizes for Electric Suggestions.—The local government of the Province of Liege, Belgium, have been closely considering how best to reorganize their existing and projected generated stations in order that the electrification of the province may be most advantageously effected In order to assist them in the solution of this problem they are offering four prizes, one of 25 000 francs, one of 15,000 francs and two of 10,000 francs for the four best schemes which may be submitted on or before March 1st, 1922. Full conditions as to this competition and details of the present position of electricity supply in the province may be obtained from the Governor

An Electric Distiller to provide distilled water for various uses has been developed in England. This device consists of three superimposed compartments. The water is boiled in the bottom one condensed in the top one, and caught in a distilled condition in the middle compartment, which is provided with a draw-off The condensing compartment has a domed cooling-water jacket, a ¾ inch cold-water inlet at the bottom and a 1 inch screwed boss at the top which serves as an overflow outlet for the cooling water. The distiller is made of solid copper with tinned interior surfaces, gunmetal handles and brass fittings. There are no coils for fur or lime to accumulate in and the hardest water is quite easily dealt with.

A New Design for Resistance Units has made its appearance in England for which several special advantages are claimed. 1 The new resistance units have a very large radiating surface for a given capacity 2 Small weight for a given capacity 3 Absolute freedom for expansion 4 Owing to the large surface and small bulk of metal they cool very quickly 5 They are absolutely unaffected by vibrations or jolts. 6. Units can be run red hot without danger of sagging 7 Repairs can be effected on separate units. 8. Tappings can be taken off anywhere along the center clamp 9 The number of units being small compared with a grid resistance of equal capacity there are not many joints to cause trouble.

Wire Gage by Memory.—Some easily remembered properties of the B & S wire gage are pointed out by *Power* (1) A No. 10 wire has a diameter of 1/10 inch and a resistance of 1 ohm per 1 000 feet (2) Increasing the wire size three numbers doubles the circular mils and halves the resistance or decreasing it three numbers halves the circular mils and doubles the resistance To find size and resistance per 1 000 feet of a No. 1 cable The diameter of a No 10 wire is 1/10 inches (100 mils) and therefore an area of 100x100 or 10 000 circ mils hence No. 7 would be 20 000 No 4 40 000 and No 1 80 000 circ mils. Resistance for the conductors is No. 10 1 ohm No 7 ½ ohm; No 4 ¼ ohm and No. 1 ⅛ ohm These properties and approximations help greatly in memorizing

A New Photo-Electric Cell.—At the spring meeting of the American Electro-Chemical Society B S Cushman of Auburn, N Y presented a paper by T W Case on a photo-electric effect in audion bulbs of the oxide-coated filament type. Mr Case reported that he had been able continuously to record daylight intensity for several months past The photo-electric effect on barium and strontium filaments in audion bulbs furnishes a current of 100 to 150 micro-amperes which actuates an automatic recorder Mr Cushman showed two strontium cells and reproduced on the screen a number of daylight records which had been automatically registered by a Leeds and Northrup potentiometer One of the cells had almost the same sensitivity as that of the human eye to light The barium cells are sensitive to the longer rays the strontium cell to the shorter rays

Transatlantic Amateur Radio Tests are to be conducted between this country and England and France next December, under the auspices of the American Radio Relay League The tests will be made between December 8th and 17th They will be preceded by an elimination test among the larger Eastern amateur stations which are best equipped for such unusual work. Kenneth B Warner Secretary of the League, informs us that the amateur stations in England and France already are preparing for the December experiments which if successful will probably result in permanent amateur communication routes, with several of the more powerful stations relaying messages abroad Attempts to establish regular amateur radio communication across the Atlantic were made last February but were not successful. It must be borne in mind that the amateurs are limited in the power and wave length which they can employ and that a distance of some 3 000 miles is no mean one to achieve with such handicaps Nothing short of ultra-efficiency can permit a relatively weak transmitter to reach across the ocean

France's High-Tension Distribution Plans.—It is proposed to develop to the fullest extent the water-power resources of France and to construct large steam stations at or near the coal mines to consume refuse coal, so we learn from *Power* This energy will be transmitted at 150,000 volts to the large industrial centers. The total amount of energy estimated available would be about [illegible] kilowatts [illegible] millions water power and 1 [illegible] millions steam. The outstanding features of the plan are as follows: 1—Those plants located close together will be interconnected and their output transmitted to the points of utilization. There is to be no interconnection between different transmission lines at the receiving end however in order to avoid trouble in voltage control and to safeguard the individual rights of distributing companies. If the power demand in any one center is of such magnitude that it must be supplied from several [illegible] [illegible] will not be [illegible] but kept entirely separate, and the consumers will be divided [illegible] them. 2—It is further proposed to store [illegible] peak energy in the steam plants by [illegible] [illegible] water for use during [illegible] periods.

Miscellaneous Notes

Rivalry in the Toy Market.—The Japan Toy Company have had to discharge many employees; German competition is blamed for the dwindling demand for Japanese toys.

High Cost of Clothing.—In England a suit has been sold for £25 000. It is a suit of armor made by Jacob the Armorer for the second Earl of Pembroke, and it was bid up to this figure at an auction sale.

"Treat it with Respect."—This is how the Department of Agriculture warns farmers to whom they are giving 12,500,000 pounds of salvaged war explosives for land clearing This material is designated as "comparatively safe."

Scars of War are Disappearing.—It will soon be hard to trace the famous front line of the great war New trees are springing up in place of those blown to pieces, and the unheaved subsoil is transforming itself into verdured stretches.

School for Ships' Surgeons.—The Broad Street Hospital purposes to establish a graduate school for ships' doctors; it will instruct them in all recent developments, especially those pertaining to tropical fevers, leprosy, and other exotic diseases.

Immigration Research.—It is proposed to create a permanent commission to assist the International Labor Bureau. This commission would devote its energies to studying the movements of peoples between various countries, and to important related questions.

Historical Sentiment in the Discard.—The proposal to sell the historic meadow where the barons forced King John to sign Magna Charta loosed an impassioned protest in the House of Lords, and the property was finally withdrawn—after there were no bidders.

New Air Mail Route.—The contract is for delivery of mails by seaplane between Seattle and Vancouver, B. C., with not more than ten round trips a month, to connect with incoming and outgoing steamers. The compensation is fixed at $200 a round trip.

Indians Improve Living Conditions.—Indians under Government control were allowed $562,872 in the first six months of 1921 for farm improvements, including 160 new houses and 68 barns. Modern bathtubs, player-pianos and electric lights are to be found among these Indians.

Home of the Siren Sold.—The famous rock of the Lorelei, on the Rhine, has been purchased by an athletic club, with the object of safeguarding it from disfigurement and from usages out of keeping with its historic surroundings. The rock is distinguished by a remarkable echo.

Why Panama Hats Are Expensive.—The Panama hat, which, by the way, usually comes from Ecuador, is made from the leaves of a small palm These are cut as they are about to unfold, the veins taken out, and the rest dipped in boiling water tinged with lemon juice. The weaving must be done when the humidity is greatest; an ordinary hat is completed in a week, but one of the first quality may take six weeks. Those of Monte Cristo surpass all others in fineness and lightness.

Posterity to Hear Caruso.—It will be consoling to all music lovers to learn that about 200 different selections as sung by Caruso will be available for future ages. The metal matrices, kept with the greatest care, can be used to make millions of records without appreciable deterioration. At his death there were more than 20 new records still to be released. Caruso was singing for phonographic reproduction for 20 years, and his total income from this source is estimated to have been $1,500,000. The royalty has long been 10 per cent. of the catalogue price, and this will go to his heirs as long as his records are sold. When he died, his contract, made in 1911, had still 14 years to run

Picture Hanging Without Wire.—Kelvin's five-point principle has been applied to picture hanging. Black-enamelled electric conduit tubing makes a good rail, which is supported on brackets fixed to the wall at the desired height. Two bent iron hooks fastened to the upper edge of the picture frame engage this rail The fifth point of contact is provided by a round-headed screw upon which the lower edge of the frame rests, to set the face of the picture at the right cant. This leaves the picture a degree of freedom sideways. With this method of hanging, a picture can be removed from the wall instantly, an important consideration in case of fire. The same principle may be used for the support of apparatus in a physical laboratory

The Renaissance of the Bath.—The Romans were inveterate tubbers; indeed even now some of us vaguely connect this habit with the fall of Rome. Then came a long period when civilization rejected the bath. The first bathtub used in America was designed by Adam Thompson in 1842, and press, pulpit, medicine and the public united in condemning this innovation. Philadelphia seriously considered making bathing illegal between November 1st and March 15th. Virginia laid a tax of $30 on every tub, while Boston actually made bathing unlawful except on advice of a physician. Then, in 1851, President Fillmore installed a bathtub in the White House, and made it [illegible] fashionable. Now our hotels boast [illegible] bath in every room, and the compulsory [illegible] philosophers who [illegible] the tub [illegible] with celestial labor.

Special Starrett Micrometer with Cut Out Frame Now Made with Metric Calibrations

Machinists are often called up to measure dimensions of parts so located that the ordinary micrometer frame cannot be inserted to take the measurement. The Starrett No. 230 one-inch micrometer having a frame so cut down that it can readily be used in places where the usual micrometer frame will not go, is especially designed to meet such requirements. Until recently this tool has been produced only in English measure. In response to urgent and continued demand, however, The L. S. Starrett Company has recently placed upon the market a similar tool—Starrett Micrometer Calipers No. 230-M—calibrated to metric measure and having a capacity of 25 millimeters by hundredths of a millimeter. The width of the anvil end of the frame is approximately 11/32nds of an inch The micrometer is equipped with both the Starrett lock nut and ratchet stop devices and is described and illustrated in the new Starrett Catalog No. 22 "B"

Starrett Adds to Line of Caliper Heads

It frequently happens in metal-working shops that none of the commercial ready-made measuring tools or gages available are well adapted to the requirements of some special job For such purposes special fixtures are made to meet the occasion. To provide such fixtures with a required degree of adjustability of measurement a *micrometer caliper head* is frequently incorporated in its structure. By such an arrangement the fixture becomes an instrument of precision with which accurate measurements can be taken of any dimension varying within the range of the caliper head used

Until recently the Starrett line of micrometer caliper heads comprised only caliper heads of one inch or 25 millimeter sizes. Lately however The L. S. Starrett Company has produced a new series of caliper heads in the half inch and 13 millimeter sizes.

No. 463 is graduated to read by thousandths of an inch up to one-half inch No 464 is similar in capacity but is graduated for measurement by ten-thousandths of an inch No. 463-M is the same as No. 463 except that it is calibrated in metric measure, being graduated by hundredths of a millimeter up to thirteen millimeters.

These new caliper heads, No. 463 463-M and 464, are described and illustrated on page 162 of the new Starrett Catalog No. 22 B published by The L. S. Starrett Company at Athol, Mass.

Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

Discriminating Snakes Natives of Liberia rub garlic on their feet finding that venomous reptiles run from the odor

Llamas in Patagonia.—It is reported from Buenos Ayres that 3 000 000 000 guanacos or wild llamas range the pampas of nothern Patagonia

Millions of Fish Die—Hot weather and little wind combined to cut off the supply of oxygen from Wisconsin lakes resulting in an alarming mortality among the finned population

The Thyroid Gland as Scapegoat.—In New York a woman burglar declared her glands made her do it a physician testified that her disease hyperthyroidism gives rise to criminal tendencies

Dr Joel Asaph Allen Professor Emeritus of the Department of Biology at the American Museum of National History died August 29 at Cornwall on Hudson aged 83

To Excavate Armageddon—John D Rockefeller Jr has given $60 000 to enable the University of Chicago to excavate on the site of Armageddon where the first battle known to history was fought

The Origin of Granite—American scientists plan an expedition to South Africa for the study of unusual geological formations north of Pretoria it is hoped to shed light on the origin of granite long a perplexing question to the petrologist

Relics of the Dragon's Den—This cave near Mixnitz Austria while being worked for bird lime phosphate revealed interesting evidences of ancient occupation Many quartz implements and utensils and human bones have been taken out

Rome Believes in Thunderbolts.—Rome reports that the Obelisk in the Piazza di San Pietro was slightly damaged by a thunderbolt but makes no mention of any fragments of the meteorite having been found

Tattooing May Be Costly.—Soldiers in Hawaii lose much time in hospital as a result of the tattooing craze Such sickness is now declared punishable and pay is stopped for the duration of the disability

Tire Punctured by Rattler—Automobilists ran over a rattlesnake near Ferndale N Y In a punctured tire was found a fang one and three-eighths inches in length The snake measured 5 feet 7 inches and had 17 rattles

A Letter from Augustus.—In Cyrene the ancient Greek colony in Africa has been found on a block of marble the translation of a letter from Augustus on the government and the administration of justice this will form a basic source for a history of his reign

Bell's Noisy Youth.—The story goes that Alexander Graham Bell shouting to a friend over one of the earliest telephones was nearly ejected by his landlady on complaint of her suffering odgers Today we have a telephone to every nine persons in the land

Exploring the Amazon.—A writer who claims to be familiar with the ground declares that the reported expedition of scientists to Roosevelt's River of Doubt country can result in no gain to civilization that the headwaters of the Amazon are well known that the lost trail has never been lost and that the great possibilities of the Amazon watershed should be studied by selecting small areas for thorough examination

A Mansion for Rats.—The Wistar Institute of Philadelphia is building a $80 000 home for rats There will be an office a laboratory a rat gymnasium and everything the rodent heart could wish for The object is observation and experiment, particularly in the direction of food research

Airplanes as Picture Palaces. Is air travel already wearying us and becoming as an old song? At the Chicago Pageant of Progress the 11 passenger hydroplane Santa Maria carried an operator and a suitcase projector to beguile the tedium of flying with motion pictures while hydroplane and audience were hurtling through the air at 80 miles an hour

Crossing of Species.—An attempt to cross inter-species of the tobacco plant *Nicotiana* resulted in 20 fertilization out of 911 flowers experimented with Of 19 combinations says *Science* only four proved fertile in both crossings and reciprocals and 4 were fertile in one way only while 11 were infertile No plants have ever been obtained from the seeds.

Concerning the Bee.—A recent discovery reveals that the oldest known bees are from Baltic amber (Oligocene Tertiary) and that other Hymenopterous insects, such as wasps, ants, etc are from the Eocene From the appearance of the Hymenoptera in the Eocene it is supposed that this group had its appearance in the Cretaceous.

Farewell to the Toy Balloon.—If a gay-colored toy balloon, straining bravely at its tether doesn't give you a thrill you may be sure that mental old age has overtaken you; enjoy the thrill while you may for the Bureau of Combustibles of the New York Fire Department is preparing to banish the toy gas balloon. One child in the city has already died from inhaling the flames from a balloon that ignited from an open gas jet. When Jersey City officials experimented by holding a lighted match ten inches from one of these painted bubbles of hydrogen gas it burst igniting the gas They have already forbidden the jitneys that run to and from amusement parks to fly balloons as decorations. The authorities are loath to deprive the children of their pleasure but they regard the menace as serious

Survey of Yellowstone Animals.—Edmund Heller who was with Roosevelt in Africa is making a study of the distribution of the deer bison grizzlies antelopes and other wild inhabitants of the Yellowstone National Park It will be the first comprehensive survey by a naturalist He will seek personal acquaintance with the leading local characters and get their own private histories.

The American Chameleon—We learn from *Aquatic Life* that the color changes of the common chameleon *Anolis carolinensis* are neither so varied as is popularly supposed nor is there a pronounced tendency or even ability to stimulate the colors of its surroundings As the American chameleon is not a true chameleon it is obvious that the connotation of its false name is not impaired

A Monument to Stone's Memory—Dr W E Stone president of Purdue University and an ardent mountaineer met his death in the Canadian Rockies after being the first to accomplish the ascent of Mt Eanon At the point where he fell 10 300 feet above sea level his friends have erected a monument of loose stones and a flask set into the mound contains a writing that describes his feat His wife who accompanied him on the climb spent four days on a narrow ledge before being rescued

A Mammoth Scrap Book—Every line of war news printed by the *New York Times* from start to finish of the conflict has been clipped mounted on red bordered sheets, submitted to a 3 ton pressure to extract moisture and bound into a consecutive history of more than 300 volumes and 81 242 pages at a cost of $20 000 We have this war news preserved in as permanent a form as skill can compass and what is probably the most complete scrap book ever made is now in the library of Princeton University

Playthings of Ancient Rome—In the tomb of a little Roman girl who died nearly two thousand years ago has been found a touching collection of toys A coin clasped in her hand was to pay her ferriage across the Styx her favorite dolls with their cosmetics were beside her with a little tea table and a miniature silver candlestick there were bright-colored building blocks a gold filigree brooch and a bracelet and tablets and a stylus The collection in a fine state of preservation goes to the Berlin Museum

Music for Mail Clerks.—The early morning lassitude of the night shift of the Minneapolis post office has been turned to cheerful efficiency by the installation of a phonograph Carefully chosen records soothe the nerves and raise the spirits of the workers Jazz is religiously reserved for the final lap for as E A Purdy the postmaster says he doesn't want the men juggling and tossing about letters and parcels. The idea was put into practice only after a close psychological study of conditions

An Extraordinary Story Two native girl students in an African mission school awakened by the squawks of excited fowls found a 15 foot python with its head in the hen roost They chopped him in two with an ax Pyjama clad Methodist preachers arrived and investigated the snake's interior to find seven frying-size chickens a setting hen and her nine eggs. The eggs, unbroken were put under another hen who triumphantly hatched them Rev E H Richards tells this story and refers to the Bishop of Africa as a corroborating witness.

Ant Bears as Insecticides.—South American ant bears have been imported into the State of Washington by fruit and vegetable growers in an effort to keep down the grasshoppers, melon bugs and aphides that infest the northwestern States. The animals are continuous eaters and are thriving on their abundant diet. The ant bear is a furred animal about the size of a spaniel with a ridiculously long pointed snout In winter these animals will live in greenhouses, where their sinuous tongues will keep the tender plants clean of insects

Relics of Abraham's Birthplace.—Many interesting finds have been uncovered near Abraham's birthplace. Among them are hollow heads of copper and iron with eyes of jasper and with teeth and tongues fastened in with copper wire There are also two columns unique in the annals of archaeology; the wooden cores have crumbled into dust, but there remain the sheathings of diamond-shaped, red, white and blue tesserae, on copper wire Another find is a relief in copper of two stags attempting to escape from the clutches of a lion-headed eagle, probably symbolizing the ascendancy of Lagash over hostile towns.

Patents and Trade-Marks

General Principles, Current Comment, and Interesting Decisions

Trade Marks in China—The trade mark situation in China is in a very unsatisfactory state. Until a national registration law is enacted with the necessary machinery for the enforcement of the registration rights and the prevention of infringements exporters should not place too much reliance on the protection afforded by a compliance with the present Chinese practice. In addition to following the Chinese procedure it would be well to see that the trade marks are registered in the countries from which similar goods might be exported to China. Because of the proximity of Japan it is particularly important that the trade marks be registered in that country as a further means of protecting the Chinese market.

Holland's Patent Law—Under the new patent law in Holland provisions are made to obtain information by the Dutch patent office examiners with reference to the art which may be cited by the examiners in patent offices in other countries. When patent applications are filed in Holland and several other countries where examinations are made as to the novelty of the invention the Dutch examiners may obtain copies of the official letters issued by the patent offices in the other countries, and review the art which has been cited during the examinations previously made. This will prevent duplicate searches and lessen the work of the Dutch examiners. Similar provisions might be copied to advantage in the United States patent practice.

New Use of Old Method—As a general proposition it does not require the exercise of the inventive faculty to apply an old method or process used in one art to a similar purpose in another art where the resulting effect is *in principle* the same. To this effect the Court of Appeals to the District of Columbia has recently restated the law *in re Brasselton* (273 F 759) holding that a process of coating or impregnating shoes with metal, by heating the metal to a liquid and blowing it in the form of a spray by a blast of gas against the parts of the shoe is not patentable where the same process had previously been applied in coating metal paper fabric glass and other substances as an old process applied to a new use is not patentable when it performs substantially the same function.

Protection Against Foreign Infringer—An American manufacturer can prevent a foreign concern from importing and selling in the United States merchandise bearing labels similar in many respects to those used by the American manufacturer and including a word which clearly infringes the manufacturer's trade mark as follows. He can lay a complaint with the Federal Trade Commission he can institute a suit in equity for infringement and unfair competition and if he has a federal trade mark registration he can file a certified copy of the same with the Secretary of the Treasury together with a number of ordinary copies and request that these copies be *forwarded* to the various ports of entry in the United States with instructions that the merchandise of the foreign company bearing the infringing labels and trade mark be denied entry into the United States.

Patents in the Balkans—There has been an awakening of industrial life in the Balkans since the Armistice. During the war the Balkan States were brought into close contact with the most progressive countries industrially. This educational period although limited to war activities, is now bearing fruit, and we see the growth extending broadly in many industries. Social and industrial growth is the forerunner of new laws. Among the laws which have recently been enacted have been patent laws for the protection of inventions in Greece Jugo Slavia and Bulgaria. Until the passage of these laws it was impossible to protect inventions in Bulgaria and in Servia, which is included in Jugo Slavia. The new law in Greece provides rules for the grant of patents. Before this law went into effect inventions could be protected in Greece only by a legislative grant.

Employer and Employee—A question of patent law which arises with great frequency is that of the relative rights and liabilities of employer and employee, where the latter creates an invention during the time of his employment. Is the employer under such circumstances entitled to the invention of the employee or any interest therein? As a general proposition in the absence of an expressed agreement to that effect, the employer has no right whatsoever to an invention of his employee. At best, should the employee have devised the invention during the time of his employer and have reduced it to practice on the time of his employer or in the place of employment, and with the tools and materials of his employer the latter may acquire a shopright, i.e., a personal license to continue the use of the invention so created. He does not, however, have any right title or interest in and to the invention itself or any letters patent which may be granted and issued therefor.

Novelty in Combination of Old Elements—A recent decision in the United States District Court of the District of Connecticut (*Cornea Artificial Limb Co vs Dubuo th A m Co* 273 F 858) reiterated two well-known principles of patent law. First, that a new combination of old elements may constitute invention where such combination produces a new result and secondly that a patent for a device which is inoperative or fails to accomplish the desired end is not an anticipation of one which successfully accomplishes it. In its decision the court relied on the rule stated by the Supreme Court of the United States in *Loom Co vs Higgins et al* 105 U S 580 where the court said "Now that it has succeeded it may seem very plain to anyone that he could have done it as well. This is often the case with inventions of the greatest merit. It may be laid down as a general rule though perhaps not an invariable one that if a new combination and arrangement of known elements produces a new and beneficial result never attained before it is evidence of invention."

Patent Office Interferences—To the patent lawyer or the inventor well versed in and familiar with patent practice the frequent occurrence of Patent Office interferences *i.e.* conflicts between co-pending applications for the same invention by different inventors is not strange though the uninitiated inventor frequently will regard such a happening with suspicion and he *is* prone to believe that the other having the same idea must have obtained it in some improper manner. But it must be remembered that human minds are similar in kind and function and people will think along similar lines particularly on matters of public interest and discussion or in connection with happenings or necessities common to many. The same invention if it is a more or less obvious one will be independently created again and again by many individuals far apart geographically and in point of time. Thus some years ago there was a Patent Office interference involving fifty and more inventors each of whom had independently conceived the same invention for the automatic stabilizing of aeroplanes by pendulum devices. These inventors were scattered over the entire country and included many of the prominent pioneers in the field of aeroplane development and more particularly the Wright Brothers Curtiss Herring and Chanute.

Abandoned Trade Mark—For many years a merchant had been manufacturing a toilet preparation under a certain trade mark which had become well known throughout the trade. He was notified by a competitor that his trade mark infringed one which the competitor had adopted many years before the date when the merchant adopted his. Upon careful investigation in the trade it was learned that this was true but that prior to the time when the merchant adopted his trade mark and began to use it his competitor had closed out his business and discontinued the use of his mark. When the merchant received the warning letter he could not find that his competitor was using the mark or that he sold it with his business.

In this case the facts show that there was an abandonment for a period of some fifteen years by the competitor and that due to this abandonment he has lost all his trade mark rights. It is true that *intent* to abandon plays a large part in determining whether actual abandonment has taken place but in cases where the trade mark has not been used for many years as in that just cited it is to be presumed that the competitor intended to abandon his mark and that it was open for appropriation by the public. Under these circumstances the manufacturer would be entitled to exclusive use of the trade mark as against his competitor.

Some Trade Mark Fundamentals—A trade mark can be assigned only in connection with the good will of the business with which it is used and the assignment must be recorded in the Patent Office within three months of the date thereof otherwise the assignment is void as against a subsequent purchaser for value without notice.

The granting of registration of a trade mark does not necessarily confer absolute ownership of the mark upon the registrant. The certificate of registration is however prima facie evidence of ownership and will be recognized as such by the courts.

An application for registration of a trade mark must be limited to such goods as are classified in one class by the Patent Office. Separate applications must be filed to cover goods classified in different classes.

A trade mark to be registrable and in fact to be a trade mark must be used in actual physical association with the goods or upon the packages in which the goods are shipped. Mere reference to a trade mark upon stationery or in advertising matter is not trade mark usage.

A certificate of registration of a trade mark remains in effect for a period of twenty years. At the expiration of that period the registration may be renewed for a like period by complying with the Patent Office requirements. Applications for renewal should be filed during the six months prior to the expiration of the registration. A trade mark lives as long as it is actually used as such and has no limitation of period as has a patent.

Civil Engineering Notes

Abstracts of Important Recent Papers and Published Articles

A Nice Vacation—The White Star Line has granted facilities to Liverpool University that will give engineering students experience at sea during their vacations.

German Locomotives for Roumania—From Bucharest comes the news that Roumania ordered 200 locomotives from Germany to be delivered in August.

Italians are Accused—Swiss railway carriages returning from Italy are often found to have been stripped of blinds seat coverings leather and even electric fittings.

The Propulsion of Ships—In 1914, 89 per cent of the world s ocean-going tonnage used coal as fuel in 1921 only 72.3 per cent depended upon coal Propulsion by the internal combustion engine has increased fourfold.

Keep Tabs on Your Automobile Springs—Once a month motor car springs should be examined and any play taken up by tightening the nuts a strip of leather put under the clips at the small end of the spring will help

American Brains in China—Dr J A L. Waddell, an American is appointed by the Chinese government as one of four advisers to examine designs for the new bridge across the Yellow River

Hydraulics Has a New Journal—The *Journal of Hydraulics* is a new quarterly issued by Hodder and Stoughton of London to disseminate the details of world developments in hydraulic engineering

Deterioration of Reinforced Concrete Marine Structures—Two papers were contributed to the conference upon this subject which is of great importance to the future of reinforced concrete for harbor work

Replacing the Automobile Cylinder Head—After the cylinder head has once been removed and replaced it should be tightened up by screwing down opposite nuts a turn or two at a time working gradually around the head otherwise there is likelihood of springing the head

Tunneling Knowledge Sought—C M Holland, chief engineer of the New York-New Jersey vehicular tunnel has sailed for Europe to study English and German tunnels particularly the methods of ventilation and the best kind of lining for the tubes.

Palestine s Great Projects—Urged by the shippers of Jaffa the government of Palestine is to enlarge the ports of Jaffa and Haifa further projects are the erection of a water-power plant sufficient for all Palestine, the irrigation of the Jordan valley and the building of a railroad from the Sea of Galilee to connect with the Bagdad Railway

Newcomen s Memorial—Newcomen the Dartmouth blacksmith who developed the cylinder-and-piston steam engine has had erected to his memory in the town of his birth a memorial consisting of two engraved brass tablets mounted on a large block of rough granite. His first engine was set up near Dudley Castle in 1712 and he knew no rival until Watt appeared

Simplon Tunnel No. 2—The first Simplon tunnel begun in 1898, was opened to traffic in 1906 It presented appalling problems such as the diversion of hot springs and in one instance a rock pressure so great that it took 18 months to pierce 50 yards. The second Simplon tunnel was originally dug as an aeration gallery for the first the enlargement of this gallery to a full-size tunnel is now practically complete.

Bamboo Reinforcement for Piles—Quantities of concrete piles reinforced with stripes of bamboo, says *The Engineer* have been employed with success on the Szechuen-Hankow Railway China. The piles are 10 inches by 10 inches by 30 feet long and are reinforced by four ¾ inch strips of green bamboo, placed at each corner and wired together with square loops, also of bamboo, placed one foot apart.

Hydro-Electric Course—The University of Grenoble, in France, has for many years made a special feature of instruction in water-power and power transmission. A series of vacation lectures with visits to some of the numerous installations in the neighborhood were held during the past summer The hydro-electric technical course will in all probability be a regular feature every summer

American Equipment for French Railways—The Midi Railway of France has placed an order amounting to $1,200,000 for electrical equipment with one of our leading manufacturers. It includes transformers, condensers, lightning arresters and various other equipment for substations. The section on which this equipment will be used has a total length of over 100 miles and extends from Pau to Toulouse, in the Pyrenees Mountains near the Spanish border

Economic Length of Cantilever Bridges—Writing on the comparative economies of suspension and cantilever bridges, Charles Evan Fowler says that the span of equal costs will probably be found, in comparing cantilever and suspension bridges for any particular case, to hover closely around 1 700 or 1 800 feet. It will vary somewhat with the particular designs compared; thus a wide difference will be found for a suspension design with fixed towers and one with hinged towers.

Rumanian Railroad Construction—The program of the Rumanian Ministry of Public Works has provided for the construction of the following railroad lines: Livezeni-Bumbesti, 37 kilometers, to establish direct communication between the coal districts of the Jiu Valley and old Rumania Brasov Nehoiu, 100 kilometers, to relieve the congestion on the Brasov Predeal-Ploesti line and Ilva-Mica-Vatra Dornei, to connect the Transylvanian system with Moldavia and the Bukowina.

Hydro-Electric Plants in Mexico—For some time Mexican authorities have offered inducements for the establishment of hydro-electric plants in or near the Federal District, the plant of the existing power company being inadequate for the needs of the region. A decree has been issued reducing Federal taxes on the use of water for power and irrigation and the press announces that two Mexicans have now submitted a proposal for the erection of such a plant.

South African Electrification—The latest reports regarding the proposals for the electrification of certain sections of the Government railways of the Union of South Africa are to the effect that no bids have as yet been accepted, and that it is possible that the program may not be carried through at this time to the full extent planned for It is reported that uncertain business conditions may influence the Government to defer this work to some extent.

Extemporized Radio Service—To make possible communication between the many camps of a hydro-electric installation in the mountains of California a novel system of wireless telegraphy was adopted. The antennae were hung from tall pine trees Satisfactory communication was obtained at an elevation of 10 000 feet between stations 7 and 18 miles apart. It was found that a continuous wave using a current of 1½ amperes gave better service than a dampened wave of 4 amperes

At Ancona, the most important seaport of the Rome section of Italy four berths are ordinarily available at the quay for discharging coal, two of which can accommodate steamers of from seven to eight thousand tons while the others are capable of handling vessels of from four to five thousand tons. In emergency cases other docks, customarily devoted to loading and unloading general merchandise can be used for coal. The depth of water alongside docks is 26 feet, and lighters are in hand for unloading vessels of deeper draft.

A Piledriver Extraordinary—What might well be called a piledriver extraordinary is described in the *Engineering News of Record* Damage by marine borers made it necessary to remove some piles under a wharf at Port Costa, Calif and a special driver was prepared for this work. It was built up on a pontoon and had a mast 90 feet high and jib 110 feet long These dimensions made it possible to reach over the pierhead and drop the new piles through small openings made in the roof Some of the piles were driven at a distance of 90 feet from the water front of the wharf

Twenty Years' Advance in Locomotives—At a recent meeting of the American Society of Mechanical Engineers, Mr W E. Woodward stated that 20 years ago it was considered good practice if seventy horsepower could be developed for every five tons of the weight of a locomotive. Today it is common practice to obtain 100 horsepower for the same weight. The locomotive of today of 3 500 horsepower weighs about 350,000 pounds. If such a locomotive were designed according to the practice in 1905 it would weigh at least 500 000 pounds; it could not be accommodated on railroads; and the boiler would be so large that it could not be properly fired.

The Bearing Power of Soils—A paper on this subject has recently been prepared by Mr A L. Bell of the Institution of Civil Engineers. Mr Bell has already made a valuable contribution to the subject by the 1915 transactions of the Inst.C.E. ; his conference paper comprises an interesting historical summary of the subject which will provide a very useful list of preliminary reading for engineers who feel encouraged to attack this important subject. We gather from Mr Bell's paper that he agrees with the view often expressed, that the principal need of the present is the development of formulæ for practical use which embrace the results of the most recent work upon the subject.

The Port of Paris serves only the city of Paris; its development is interesting. The [illegible] wharves were at first entirely used to handle [illegible] [illegible] and [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] below the [illegible] [illegible] [illegible]

provements are planned that will make Paris accessible to seagoing vessels a canal from the Marne will lessen the danger from floods and open a direct route to the sea from the Sarre region Coal and building materials are now three-fourths of the imports, and 35 per cent of outgoing shipments consists of building wreckage and refuse. It is possible the future may see Paris an important transhipping port.

Cement Industry in South Africa—There are but six cement factories in the Union of South Africa and none of them of any great capacity we learn from *Commerce Reports* A cement company proposes to erect a plant at Cape Town with a capacity of 500 000 bags of cement annually The imports of cement during 1920 amounted to 50 717 000 pounds valued at $582 029 (at normal exchange) During 1920 practically all of the cement came from the United Kingdom Canada, Belgium and Germany the United States only furnishing 16 800 pounds The demand for cement is increasing and should conditions improve so that the long delayed housing schemes can be carried out there will be a considerable demand for imported cement.

Again the Rhone Project—The Rhone from the Swiss frontier to the sea is capable of supplying power on a large scale if only its resources were were tapped. It is estimated that if all the French waterways were utilised 9 million horsepower could be generated of which the Rhone would furnish 1¾ million horsepower Plans to create power plants on a large scale were laid down several years ago As far back as 1902 there was a project to build a station on the upper Rhone capable of generating 200 000 horsepower which could be transmitted to Paris for lighting purposes at a very cheap rate The Swiss authorities expressed themselves in complete accord with the scheme, as far as affects the head waters of the river The first plant would be erected at Genissiat, and the second at Chanas-Peraux. These would trap the whole of the waters between the source and the last-named town

Impact Allowances for Bridge Design—Mr H J Fereday contributed a paper at the recent meeting of the Institution of Civil Engineers upon this subject which has exercised the minds of engineers since the days of Fairbairn and Wöhler It is still a moot point whether the phenomena generally popularly collected under the term fatigue of metals require separate treatment in design from those resulting from impact or dynamic action Mr Fereday states that although a large number of experimental investigations have been made upon the actual stresses (or rather strains) caused in bridge members during the passage of a train over the bridge the results have not been analysed with sufficient thoroughness to enable a rational formula to be deduced for use in practical design He suggests that we should first measure upon a given bridge (1) the maximum stresses produced by a live load crawling over the bridge (2) the corresponding maximum stresses produced by the live load at the highest permissible or critical speeds If we plot diagrams showing the variations of these stresses along the span the difference in the two curves will give a measure of the impact effect

The Tallest Concrete Building—The tallest reinforced concrete building in the United States is one recently erected in New York City It stands on a site approximately 75 feet square and is eighteen stories high From the basement to the top of the roof the building measures 228 feet high Work was begun in October 1920 and finished early this year To guard against freezing the concrete was delivered into the molds steaming hot and the molds were kept sufficiently warm by means of special heaters As one floor was molded every week care had to be taken to avoid excessive strains in the green concrete and five successively completed floors were kept shored during the greater part of the time The exterior surfaces of the building consist of white Portland cement and colored aggregates including quartz feldspar and green stone chips the lowest stories being finished by bush hammering and the sixteen upper stories by the aid of an electrically driven carborundum grinding machine The general effect of the surface treatment is said to be excellent. We have asked one of our contributing editors to prepare a story on this novel building which will appear in an early issue

Bridge vs. Tunnel for Hudson River—That railway tunnels will usually be cheaper than railway bridges for spans exceeding 2 000 feet when property damages are taken into consideration that a highway bridge would be cheaper than a highway tunnel even for a 3 000-foot span unless property damages are quite heavy and that short-span lengths favor a bridge while long-span lengths favor a tunnel are some of the facts set forth by Dr Waddell in a communication to the American Society of Civil Engineers. Dr Waddell claims that safe ventilation of a tube carrying automobile traffic is as yet an unsolved problem and he quotes certain authorities to the effect that carbon monoxide even in minute quantities is a cumulative poison which would gradually undermine the health of those constantly using such tunnels The high temperature (20 deg. Fahr above outside air allowable by the designers) he believes would cause much discomfort in summer He states in conclusion that although Mr Lindenthal's single bridge for many lines of traffic might apparently be cheaper than the equivalent tunnels necessary when the property damages for long railway approaches are duly considered it would be found cheaper to carry all the railway tracks in tunnels and carry highway traffic by the bridge.

Applied Chemistry Notes

Condensed Information Gathered from Chemical Journals and Other Sources

Adolphe Wurtz Honored.—A monument in memory of the French chemist, Adolphe Wurtz, was unveiled recently at Strasbourg

Removing Paint and Varnish.—An inventor has just obtained a patent for removing paint and varnish from automobiles with a hot solution of sodium hydrate or other solvent applied with an air blast.

A Fireproof Paint.—A fireproof paint has just been patented consisting of 10 parts of milk, 5 parts sodium tungstate, 10 parts of borax, 10 parts of gum arabic, 20 parts of kaolin, 10 parts zinc white, 10 parts sodium silicate, 6 potassium silicate and 10 parts of feldspar

A New Cement for Leather.—Two English inventors have patented an adhesive composed of naphtha. The balata dissolved in a solvent like naptha. The balata is cleaned by boiling and rolling into sheets, which are kneaded under steam pressure and then exposed to the solvent.

Increasing the Capacity of Moisture in Bread Dough.—Two inventors have recently secured a patent on the use of calcium peroxide in bread-making About 007 per cent of calcium peroxide to the weight of the flour is incorporated in the bread dough to increase the capacity for moisture.

Rich Vein of Copper Found in Shetlands.—A copper vein of great richness has been discovered in the Shetland Islands. The lode was said to have been proved to yield a high percentage of copper Experts who are erecting a plant at the mine site think that half a million tons of ore are in sight.

Jerusalem Artichoke as a Source of Alcohol.—This tuber is a splendid source of alcohol and is being largely used in Germany; but commercial fermentation of this material is now forbidden in that country The highest yield was obtained from the raw mash not steamed or treated with malt, but fermented with brewer's yeast.

Stenches for Mine Signals.—The Bureau of Mines has been cooperating with large mining companies in the perfecting of devices to warn miners of danger by means of stenches. A vile-smelling liquid is introduced into the compressed-air line and the odor soon gives its warning through the nose.

Fatal Case of Borax Poisoning.—The medical papers have reported a case where a man of 64 years of age swallowed 60 g of borax by mistake and death occurred in three hours. Household borax seems to have always been regarded as harmless, but evidently it should be used sparingly where it is liable to get into the system.

Non-Freezing Dynamite.—A very large manufacturer of explosives has just perfected a formula for a non-freezing dynamite which will displace the older type of explosive as far as they are concerned. Thawing, with its attendant dangers, is eliminated The formula is the result of years of experimentation

Food From Fish.—The cooked residue from fish oil manufacturing is crushed or ground to a paste, says *Chemical Abstracts,*" dried in vacuo at a temperature below 10 per cent, reduced to a powder treated with a proteolytic enzyme such as pepsin to solubilize the albumin content of the mass, extracted with water and the result thus obtained is dried and powdered for use as a food.

TNT Good for Road Building.—TNT in the opinion of Thomas H. MacDonald, chief of the Bureau of Public Roads, is a good explosive for use in road construction. Through this bureau 16,000,000 pounds has been distributed for that purpose without an accident. As TNT does not freeze and the fumes do not produce any ill results, it is popular with road builders, both contractors and laborers.

Chlorination by Ultraviolet Light.—Two Japanese inventors have devised an ingenious apparatus consisting of a closed chamber provided with a window having a lens of uviol or quartz glass and two tubes opening at the focus of the lens and another tube for exit of the product. Chlorination is conducted at the opening of the tubes under the influence of ultraviolet light which is sent through the lens.

Palatable Sirup From Sugar Beets.—An edible sirup is prepared by heating sugar beets in water (preferably to a temperature of about 80 degrees), separating the liquid and heating it in an autoclave to a temperature of about 100 degrees (C) for about one hour, and blowing off steam from the autoclave at about fifteen-minute intervals during the heating to eliminate substances of objectionable flavor

Cheaper Shoes.—The Leather Industries section of the American Chemical Society will discuss the question of producing cheaper shoes at the September meeting. Due to the slowness of present tanning methods, quick turnover of stock is impossible. By a new method the tanning period will be reduced to a minimum, permitting a speedier release of the leather manufacturer's capital. Cheaper leather, and consequently cheaper shoes, are anticipated as a result.

Examination of Sugar Crystals by Projection.—George P Meade stated before the section of Sugar, Chemistry and Technology of the American Chemical Society that the examination of sugar crystals by projection was feasible. Samples of raw sugar from several factories are classified each day as to size and regularity of crystal. A "balopticon," or similar device, with vertical attachment, throws an image of a small portion of the sample on a screen, magnifying it ten diameters, says *Science.* Squares drawn on the screen correspond in size to an arbitrary scale of ten, and the observer compares the image of the crystals with the squares, determining the size to the nearest whole number of the scale. The projection also shows the regularity and form of the crystals, and abnormalities are noted.

Drying Crystals.—If you require to dry large quantities of chemical crystals it will be necessary to centrifuge them, says J. Cayley Jones in *The English Mechanic.* Small amounts (an ounce or two), however, may be dried by placing them in what is known chemically as a desiccator This is a glass vessel generally containing a mixture of concentrated sulphuric acid and pumice stone cubes. The vessel is air-tight, and has a support over the acid mixture on which a small dish containing the crystals may be placed. The acid quickly mops up the moisture in the container, and thus dries the crystals, a few days generally sufficing to complete this operation, depending on the nature of the chemical to be dried. Care must be taken when handling the acid as it produces bad burns when in contact with the skin.

A Curious Acid.—Formic acid (*L. Formica,* an an ant) is found in the vegetable and animal kingdoms. If the leaf of a stinging nettle is examined with a microscopic it is seen to be covered with long pointed hairs having a gland at the base. This gland contains formic acid. When the nettle is touched lightly, the fine point of the hair punctures the skin, and a subcutaneous injection of formic acid is made, which quickly raises a blister The inconvenience which arises from the stings of bees and wasps, also from the fluid ejected by ants when irritated, is due to formic acid The remedy in each case is the same the acid must be neutralized as quickly as possible with mild alkali, such as washing soda. Formic acid was first made by distilling an infusion of red ants. It is now made from glycerine and oxalic acid.

Crystals and Water of Crystallization.—When a soluble salt is to be recovered from its solution the latter is reduced in bulk by evaporation until, either by experience or by trial, it becomes evident that the solid will be formed as the liquid cools. In some cases, when time is not an important factor evaporation is left to take place naturally Under either set of conditions, the substance generally separates out in particles which have a definite geometrical form. These are spoken of as crystals. Crystals often contain a definite percentage of water, called "water of crystallization." In sodium carbonate, this combined water forms nearly 63 per cent of the total weight; in copper sulphate it is approximately 36 per cent. On being heated to a moderate temperature, the water is expelled from the solid; the substance which is left behind is called the anhydrous (that is, the waterless) salt.

Stones Absorb Water.—Stone is by no means impervious to water Some kinds, notably coarse sandstones, hold a large percentage. Even marbles absorb considerable quantities. The absorptive capacity of limestone ranges from 7 per cent or more down to practically zero. Porous limestones, in which the pore space ranges from 10 to 15 per cent, will absorb from 4 to 6 per cent of water, whereas semi-crystalline and crystalline limestone or marbles have lower percentages of pore space and of absorption, such marbles as those from Vermont, Tennessee and Georgia being almost non-absorbent. Pumice stone, which is usually lighter than water, owing to its great amount of pore space, will absorb large quantities of water; obsidian and volcanic glass, which are of the same chemical composition as pumice stone, but several times heavier than water, will absorb none. Quartzite, granite, and the numerous eruptive rocks are practically impervious to water.

Carbon Black in 1920.—The total quantity of carbon black produced from natural gas in the United States in 1920 was 51,321,892 pounds, a decrease of 1.4 per cent from 1919, notwithstanding an increase in the number of plants. In 1919 the plants were still operating at or near full capacity on account of the war but since normal conditions have been restored the production has decreased. The output in 1920 was made by 39 plants, operated by 19 producers. The total value was $4,082,294, as computed from the prices received by the producers. The prices ranged from 4 cents to 27 cents a pound. The average daily production in 1918 was 136,000 pounds; in 1919 it was 144,000 pounds, and in 1920 it was 140,000 pounds. About 40,000,000 cubic feet of natural gas was consumed in the manufacture of carbon black in 1920. In 1920 the production of carbon black per thousand cubic feet of gas consumed ranged from 0.65 to 4 pounds, but the average production during the year for all States was about 1.30 pounds.

Notes and Queries

The Notes and Queries column is maintained for the benefit of our readers who desire information on subjects germane to the scope of the paper, together with technical formulas and similar information Matters requiring profound research or searches in a library cannot be undertaken. In connection with Notes and Queries proper, we maintain a "Service Bureau," which is able, in nearly all cases to supply addresses of manufacturers whose articles have sufficient novelty and merit to be illustrated in the news pages of this periodical Correspondents are requested to write their inquiries in all cases, making the subject of the letter entirely separate from the correspondence relating to patents, subscription, books, etc This will greatly facilitate the answering of these questions, which in many cases have to be referred to experts. The full name and address should always be given. Our full 'Hints to Correspondents" will be gladly mailed on request All letters are answered by mail and only a very few of them can be printed in the limited space at our disposal

(14363) J A. M asks For information, can you give us the required answer? Is it possible for a horse to pull in any way, shape or form, or does the horse push all the time when drawing a load, when tied, when holding anything with the saddle, when anything is tied to the tail. In fact, is it possible for a horse to pull at any time. I have money that says he can while another party has money that says that it is impossible for a horse to pull. A Your question is not so simple as it appears to be upon its face. There are various transformations of the forces to be taken into account. The horse pushes with his legs and feet backward against the ground whenever he draws a wagon forward He also pushes against his breastplate or collar by the same effort. But his push is transformed into a pull in the tugs or traces and this pull it is which moves the load forward If a rope were attached to the tail of the horse the case is slightly different. The horse pushes with his legs against the ground as before but the push becomes a pull upon the rope which is attached to his tail In exactly the same sense a man pushes himself forward when he walks or draws a load by a rope and he also pulls the load along If you see carefully the transformations of the force employed you will see where there is a push and where the push becomes a pull. The answer to the query is that there is at one time a push and again a pull in the case supposed.

(14364) I M P asks 1 Why does water that has been previously boiled freeze at a higher temperature than water that has never been boiled and at what temperature will this boiled water freeze? 2 The absolute zero being 461° F below the ordinary zero F, what is the meaning of this absolute zero? Is it a point where no radiation takes place, or is it the lowest point that can be reached? 3 What causes a 'Scotch boiler gage glass' to break when installed and under steam pressure if it has previously been in contact with steel or iron? 4 Explain why the true water level is not shown by the gage glass when the boiler is under steam pressure and why does the water level rise in the gage glass when the top cock is closed? A 1 Boiled water is practically air free, and air-free water will cool faster than water containing air, so that it comes to the freezing point sooner than water which has not been boiled We have never supposed that air-free water would freeze at a higher temperature than water which contains air We have never seen any discussion of this matter in a scientific book Perhaps the scientific men at the Bureau of Standards, Washington D C have some facts on this subject 2 Absolute zero is the temperature at which all heat has left matter, at which all motion of molecules would cease. It has never been reached It is the lowest temperature which can ever be reached if the theory is true. 3 We do not know any influence of steel or iron upon glass by mere contact which can make a gage glass break at some future time. The statement does not sound scientific 4 If either valve of the water-column is closed, the level of the water in the tube will rise If the top valve is closed, the steam in the upper part of the tube will condense and be replaced by water entering from below If the lower valve is closed, the condensation of steam in the upper part of the tube will accumulate and gradually fill the tube. If the fire is stirred up under a boiler which has been banked, the water-level rises in the tube, because the circulation is

from the front of the boiler to the rear and this circulation is maintained by a difference of level between the front and rear ends. When a boiler which has been steaming freely is checked the water level drops.

(14365) F I P asks My text books on astronomy do not specify the eleven (I think) motions of the earth please advise me what they are. A We have never seen any list of all the motions of the earth There may be eleven and there may be more The earth yields to the attraction of every heavenly body ar und it We will name a few of its motions but cannot agree to give a complete list Rotation on its axis revolution around the sun motion with the sun as the sun moves through space motion around the center of gravity of it and the moo an irregular motion so that the pole moves in the earth nutation precession of the equi noxes. Then there are the deviations made by the attraction of Mercury Venus Mars Jupiter and Saturn These last are very minute. There are doubtless others which we have overlooked Most of these are given in the larger astronom ies such as Young's Manual

(14366) G M R asks Which side of an auto or rather which wheels tend to leave the ground on turni g the machine around? Is it the inside or outside pair? What effect does a slow or fast t rn have? A If a car turns a corner too fast it overturns toward the outside of the curve and away from the center of the curve This will cause the outer wheels to press har ler on the ground and the i ner wheels to leave the ground The only difference between going slow or fast around a curve is in the degree of the danger of a overturn Go slow a d you are safe The outward thrust on the car will not be enough to cause an accident Go too fast and you can negotiate an overturn every time

(14367) G P B asks I have had my attention especially called to the Hertzian Ray Theory and as I am sadly in want of informa tion upon this subject A Hertz s work supplied the experimental proof of the Maxwell theory that light is an electromagnetic effect He demonstrated the existence of electromag netic waves by means of his resonators. You will find these experiments in a y college text-book of physics Ganot s is good so too is Carhart s. Hertz s experiments laid the basis for wireless telegraphy a d he just missed th discovery of X rays. H probably would have detected them had he not died at the early age of 37 years No scientist has been more deeply lamented than he He was recognised as one of the most promising men of his time We should not speak of a Hertzian Ray Theory We sho ld say the Experiments of Hertz in demonstrating the Maxwell theory His work, Electric Waves was published in England after his death

(14368) S O P asks (a) What is the chemical equation (or equatio s for the action taking place when (1) chlorine gas is passed through sodium hydroxide solution and (2) when an uncombined mixture of hydrogen and chlorine gases is passed through sodium hy droxide? (b) (1) What are vinegar bees and (2) how does their action compare with that of yeast or mother? (c) What is the complete explanation of the fact that when crystals of potassium dichromate or blue vit riol, etc., are crushed the color of the pulver ised substance is lighter than that of the crystal? (d) Why does the lower surface of a sheet of ice on a pavement melt in the sun before the upper one? (e) (1) In using a resistance or ballast coil in connection with a carbon arc for a projection lantern on a 110-volt circuit, how should it be adjusted to secure the most light without heating the coil? (2) If coil heats should resistance be in creased or decreased? (3) What would be proper specifications for a coil which would operate satisfactorily on such a circuit? A. (a) You will find the reactions for chlorine gas upon sodium hydroxide given in Alex Smith s Inorganic Chemistry under Hypochlorites." The book gives the reactions for potassium but of course they are the same for sodium

Cl_2 + H_2O give HCl + HOCl.

The HCl + KOH give KCl + H_2O

And the HOCl + KOH give KOCl + H_2O.

If this is reduced to a single equation it is

Cl_2 + 2KOH give KCl + KOCl + H_2O.

Write Na for the K and you have reactions for Na. Both potassium chloride and potassium hypochlorite are formed. The presence of free hydrogen gas would not have any effect. It could not enter into combination with any of the substances in the reaction (b) "Vinegar bees" are an [illegible] kind of yeast, and like all yeast will produce fermentation and thus produce alcohol. The be-

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suiting drink is not safe nor healthful. (c) The streak or scratch upon many crystals is white because the streak contains air and the air reflects the white light fully A crack or shiver is apt to show all the colors of the spectrum as in the opal Copper sulfate and many other crystals have a white streak when scratched (d) The sheet of ice on the pavement melts from the lower surface because the stone or asphalt is warmer than the air ab ve the ice The heat of the sun penetrates the ice easily and without melting the upper surface any more at least than it melts the interior of the ice The pavement below is heated more easily than ice is melted and thus becomes warm enough to melt the ice or to reflect the heat of the sun back into the ice and melt it Ice on a lake or pond melts throughout its entire thickness in the spring with the heat of the sun and falls into pieces long prismatic pieces which then are easily melted in the slightly warmer water This gives rise to the popular notion that ice sinks in the spring (e) A coil in series with an arc light in a projection lantern is used to take care of the excess of voltage in the line An arc requires 45 to 50 volts to force the current across the gap between the carbons An arc uses about 15 amperes to give a sufficient light for lantern slides. Ohm s law is amperes equals volts divided by ohms The arc takes 50 volts of the 110 This leaves 65 volts which must be taken care of in the coil But the 15 amperes flow through the coil also and the 65 volts divided by the 15 amperes gives 4⅓ ohms for the coil N w you may want 20 amperes sometimes to light up a very dense slide and 65 divided by 20 gives 3¼ ohms So that you would better have a variable rheostat having from 3 to 5 ohms in 6 sections Then you can adjust the current to the size of the picture on the screen and the denseness of the slide. With a fixed resistance in the coil you cannot vary the light Y ur idea of a coil which will not heat is way off from fact. No wire can carry a current of electricity without heating Any resistance is heated by a current else an electric light would be impossible All the current which flows through the coil is transformed into heat and thus dissipated gotten rid of prevented from burning the arc too fast as would be the case if the whole 110 volts were turned upon the carbons to produce an arc which only requires 50 volts at the most Your rheostat may be made of No 12 iron wire This will stand the heat for a long time before it is rusted out No 12 iron wire has about 105 feet to the ohm so that you should have 525 feet of wire in the rheostat If a coil heats too much its resistance must be increased else it may melt open

(14869) J S. L. writes us a very pleasant letter but complains of the fact that names of manufacturers etc are not found in the text of the SCIENTIFIC AMERICAN and suggests that possibly he would be burdening us with unnecessary correspondence if he should ask for the names We beg to advise all our correspondents that we maintain a Service Bureau which is always pleased to furnish the address which we are able to supply in practically every instance and provided the information is asked for by mail The names of manufacturers, etc, are purposely mitted from the paper as it has been our policy to keep our columns entirely free from any such matter so that our reader may always know what he sees in our paper has been prepared by our own editorial department, and is not the product of some publicity agent who is merely trying to sell his merchandise through the medium of a trade write-up

(14870) T M B says I am employed by a company manufacturing machinery and tools and have invented a new tool which I desire to have patented The tool was invented and perfected at home but, owing to the lack of necessary machinery I had to do some work during my lunch hour at the factory The superintendent of my department saw the tool while I was working on it realized how well it was adapted for use in the factory and informed me that if I did patent it I would have to turn over all my interests in the invention to the company as they have a right to anything invented by any of their employees I have never made any agreement with the company relative to inventions and to my knowledge no such agreement exists. Will you please advise me as to my rights in the matter? I am an old subscriber A An employer has absolutely no rights to the inventions or discoveries of his employees unless there is an agreement or a contract to that effect. From such information as you furnish the invention belongs to you and even though you did work on your device at the factory, this would not give the company any rights in the invention

Tours and Detours

(Continued from page 8)

To reach the west from Wheeling the well-advised motorist will steer clear of the Colerain Pike which in the road books appears as the choice. Go on to Zanesville and Columbus, and then think of striking north; or if your destination lies in eastern Ohio turn north for Pittsburgh at the big crossroads a few miles beyond Uniontown you can't miss it. The objections to the Colerain Pike are first, the rough surface and the profusion of loose stone second the extreme difficulty of staying on it in the face of instructions to follow the Pike and third the utter impossibility of finding it in the first place. We passed its head twice while looking for it. It never occurred to us that it could be anything but a billy goat trail up the hill between the back doors of the shanties. But if you can find it and stay on it and if you like sporty hilly going you will have a good deal of fun with the Colerain Pike

The other alternative is equally attractive. The Mohawk Trail combined with the Albany Post Road gives a route of unusual merit from New York to Buffalo. Except where it suffers from bad city pavements it is in extremely fine shape throughout and it is so well marked that I followed it without any guiding literature either from Buffalo to New York asking the way only once when I found no other means of locating the bridge at Albany. From Buffalo west along Lake Erie the route is a disappointment in the sense that it follows the Lake closely only here and there and for 1921 there were three detours of unnecessary length and in two cases of poor character. It looked as though these would be lifted by the end of the season however and the only one that was really serious was the one west of Erie. From the state line into Cleveland the road is particularly satisfactory. West of Cleveland one can follow the Lake to Sandusky over roads that are in first class shape save in passing through Huron and from Sandusky one strikes southward to Bellevue there rejoining an alternative road from Cleveland via Berea and Oberlin which is likewise in good shape. The wise procedure is then to steer due west through Fremont Bowling Green Napoleon Bryan Butler Ind. etc and join the Lincoln Highway at Goshen. Beyond Fort Wayne stick to the Lincoln Highway the short cut to Chicago via Warsaw includes a lot of second-rate country road. If several detours of from five to ten miles each in the interval between Fremont and the Indiana line are properly ironed out by the new year as it appeared they would certainly be this will be the best route between New York and Chicago for 1922 as regards road conditions alone.

Returning to the subject of highway markings a word may be said about the necessity for a fixed system. There is not much satisfaction in realizing after driving three or four miles that the markers have ceased and that one must go back for the turn that was missed. A single pole at a street corner a fork or a crossroads means anything and therefore nothing. "Straight Through" may be indicated by poles on diagonally opposite corners, and "Turn" by poles set squarely opposite one another in such a fashion that one must turn to pass between them. This procedure is open to two criticisms, however the strange driver approaching on the side road may be misled by the "Straight Through" arrangement to suppose that he is on the highway and since the route runs in both directions signs on three out of four corners are necessary to indicate completely a turn. Better I think is the plan of putting a marked pole on the corner and another a few yards beyond on the straight-ahead road or around the corner as the case may be. The driver then quickly forms the habit of never passing a possible turn until he has located the second pole. The sign on the first pole may usually be so attached that its arrow gives the eye a very strong suggestion of the direction in which to seek for the second one. This I find to be the chief value of the arrow as actual instructions for the steering hand it doesn't amount to much. But I should like to follow a previous mention of the subject with the following query for the ears chiefly of Ohio road authorities. When two divergent roads each purport to be the Lincoln Highway what is the motorist from another state to do about it?

As a final word I want to repeat the protest which the SCIENTIFIC AMERICAN has several times voiced against the promiscuous use of danger signs. In Ohio and Indiana I saw curves posted as sharp and "dangerous" which were so wide that at any point on them I could see fifty yards or more around them. Coming across New York hills were posted as "steep and dangerous" down which I could coast only with my clutch free—they were not steep enough to overcome the compression if I left the gears in action. Such misuse of warning signs can have no other result than the creation of a contempt for cautions in the mind of the driver—and when he comes to a place where the warning is really in order this is likely to be serious. The originator of the tale of "Wolf! Wolf!" was a psychologist

From Easel to Cover

(Continued from page 10)

Meanwhile the printing plate must be prepared. It consists of a sheet of rather thin aluminum the surface of which must be properly grained to receive the transferred images. The graining is done by means of a rocking table driven by an electric motor. The table carries a large shallow tank in which is placed the aluminum plate, covered with hundreds of marbles and a thin layer of special liquid. The rocking action of the rocking table causes a steady flow of marbles over every portion of the aluminum surface, as shown in our eleventh sketch, with a resultant fine grain finish.

The next step takes us back to the thin sheets of India paper carrying the impressions from the nine originals. These India paper sheets are now carefully mounted on a heavy sheet of cardboard, by means of little sharp-pointed steel tools. A slight blow with the sharp-pointed tool causes the thin paper to stick to the heavy cardboard. The sheets are mounted with due thought given to the registering of the other companion plates of the same cover illustration. Various pieces of transfer paper can be mounted on the cardboard; in fact one is surprised to note the ingenious manner in which the men engaged in "sticking up the sheet" can patch various advertisements, covers and other pieces of typography together

The cardboard form being duly prepared, it is placed face down on the aluminum plate as shown in our twelfth sketch and passed through a press which exerts a heavy pressure. When sufficient pressure has been applied the India paper transfer sheets are found to be firmly held on the aluminum sheet. They are carefully removed with the aid of a moistened sponge as shown in our thirteenth sketch leaving the inked images on the aluminum. These images are successively etched by means of a sponge moistened with the acid solution as shown in our fourteenth sketch and reinked until a satisfactory mechanical image results.

At this stage of the process we have an aluminum sheet containing the four sets of images for the yellow image another aluminum sheet containing four sets of images for the red still another sheet containing the four sets of images for the blue, and a final one containing the four sets of images for the black. These aluminum sheets are now placed on different offset presses and clamped on the cylinders as shown in our fifteenth sketch. Obviously the yellow plate receives yellow ink of the proper shade the red receives red ink and so on. The sticking up of the cardboard form has been done in such a careful manner that the spacing of the various images on all the aluminum sheets are in perfect register when printed on to the same sheet of paper

The principle of the offset press has already been described and the essential details may be noted in our sixteenth sketch. The aluminum plate is held on one cylinder and is inked by a set of ink rollers, and kept moistened by dampening water rollers. The aluminum plate transfers its images on to the rubber blanket, which in turn offsets the images on to the sheets of paper that are steadily fed through the press by automatic mechanism. The offset press is capable of as many as 4 000 to 5 000 impressions per hour which in the case of the SCIENTIFIC AMERICAN covers printed "four up" or four sets of plates at a time means a color is printed on 16 000 to 20 000 covers each hour. Naturally four colors require four times the number of impressions.

The offset process is peculiar in that it permits printing on coarse paper as well as highly coated paper. This is not so with the usual press, which must work with smooth paper in reproducing half tone or color work satisfactorily. The reason for this is that if too light a pressure is applied only part of the half tone dots print. If too much pressure is employed the dot is smashed into the paper with a resulting muddy heavy appearance. The usual method of overcoming these obvious difficulties with the letterpress is to employ a very coarse half tone screen 85 or even 65 lines to the inch. These screens will print more clearly on coarse paper, but naturally the dots are quite prominent and not suitable for high-class work. The offset process gives the user the choice of any paper ranging from a fine coated paper to a rough antique stock. Incidentally the best results are obtained with a rough finished paper

The Planets

Mercury is a morning star all through November and is best visible on or about the time of his greatest elongation which occurs on the 16th. At this time he is 19° 27' west of the sun, and rises more than an hour and a half before sunrise, so that he should be easily visible.

Mars is likewise a morning star rising between three or four hours earlier than the sun.

Uranus, meanwhile, is in Aquarius and visible in the early evening while Neptune is in Cancer and observable in the morning.

Venus is still a morning star. She rises about two hours, or a little more, before the sun, and is more conspicuous than any other planet for those observers who will follow her example.

In the middle of the month all the five planets known to the ancients will be simultaneously visible in the morning sky and fairly close together—an unusual occurrence.

Jupiter and Saturn are morning stars like the others, and are close to Mars. On the 18th Mars and Saturn are in conjunction, the former being 1° to the southward while on the [illegible] Mars and Jupiter are still closer only a sixth of a degree apart.

The moon is in her first quarter at [illegible] A. M. on the [illegible] full at [illegible] A. M. on the 15th in her last quarter at [illegible] A. M. on the [illegible] and new at [illegible] A. M. on the [illegible]. During the month the moon [illegible] Mars and Jupiter on the [illegible], Venus [illegible] and Mercury on the [illegible] [illegible]

SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

35¢ a Copy DECEMBER 1921 $4.00 a Year

EXTENDING THE CONTRACTOR'S WORKING DAY BY FLOOD LIGHTING

Scientific American Publishing Co. Munn & Co. New York

Two Men Who Knew Lincoln

"LET'S go out tomorrow and see the thing shoot," said Lincoln. So began Christopher Spencer's career

The story is told for the first time in this issue of the Scientific American. It is one of the last of the personal testimonies—they grow rarer as the years pass—of the imperishable kindness and the untiring interest in human affairs that were Abraham Lincoln's.

Wrestling as he was night and day with the death struggle of a nation divided against itself, the President yet made time for the young inventor who believed he had found something the nation could use. "Let's see it shoot," said Lincoln. So the vision became actual.

THERE was another young man who was helped by the President in those same days of national stress. His was the vision of drop forging pistol parts, to accelerate the supply of much needed weapons for the northern forces. Him, too, the President found time to encourage, and to C. E. Billings the message came:

"Go ahead and drop forge."

Two visions made actual by the man who found time for small things in the midst of great ones.

GIVEN the oak, it profits us not only to think of the acorn, but also of the sun and the rain and the long days of kindly time—for so we may remember that the oak is the product not of the acorn alone.

Given a great industrial achievement, it profits us to think not only of the acorn of vision in the minds of two men from which it sprang.

Something else was there: the belief of Abraham Lincoln.

VISION and belief! Great enough things to build on, even as the Billings & Spencer Company of Hartford has been built, to endure through the decades, to spread its products all over the civilized world, to hand down from father to son an unchanging ideal of endeavor and achievement.

Tall, gaunt, black-coated: the face deep lined, the eyes keen and far seeing under the bushy eyebrows—

To Spencer he said, "Let's see the thing shoot." To Billings, "Go ahead and drop forge."

"GO ahead and drop forge."

The Billings & Spencer Company has obeyed orders.

This advertisement is published by the Billings & Spencer Company, of Hartford manufacturers of hand tools, drop forgings and machinery. It is designed to supplement the article regarding Mr Spencer's acquaintance with Lincoln which is published on pages 102 and 103 of this issue

THE BILLINGS & SPENCER COMPANY

The Scientific American, December, 1921 Volume [illegible], Number [illegible]. Published monthly by Scientific American Publishing Company at [illegible] Broadway New York, N Y Subscription price [illegible] per year Entered as second-class matter June [illegible] 1879 at the post office at New York, N Y under the act of March 3 1879

With the Editors

IN bringing out our first issue of the new monthly SCIENTIFIC AMERICAN, the November issue, we felt very much like the actor in a first-night performance. How would our readers take the change? was the question uppermost in our minds. Of course, decade after decade spent in catering to the wishes of practical Americans has made us very well acquainted with the likes and dislikes of our large circle of readers; but, nevertheless, there is no gainsaying the fact that we broke away from the general style of our former weekly and monthly editions. Like the actor already referred to, we waited for the response of our audience. And now, several weeks after the first issue of our new monthly has appeared, we find ourselves showered on all sides with letters and messages of a highly complimentary tone. The response has been most gratifying—far in excess of what we had dared to hope for; and, what is most important, we find many new readers expressing their satisfaction over our new form, along with our old-time readers and lifelong friends. It does seem as if we shall, therefore, continue to serve our friends of old, while extending our circle to many new readers. So much the better, for it must be obvious to all that the larger our audience the better and greater we can make our journal. We appreciate the hearty applause that has greeted our initial issue.

INFORMATION in tabloid form is the purpose of the various departments of this journal. In the preparation of the numerous notes which appear under various headings, we read a large number of domestic and foreign periodicals, Government reports, papers read before learned societies, and other technical literature. In fact, our list of "exchanges"—that is the name given to periodicals received in our office for the purpose of review—includes well over one hundred domestic and foreign publications, not to mention the numerous solicited and unsolicited Government and engineering reports which come to hand. From a five-page article we prepare a 200-word note, but in those 200 words we endeavor to cover the main points and those of greatest interest to the general reader. This boiling down process, as it were, is one of our most important jobs, and by no means the least interesting, even though the product may not be a true indication of the amount of time and effort spent in its preparation.

FROM that wonderful storehouse of knowledge, the Metropolitan Museum of Art, came the data and the illustrations for the article entitled "The Mechanism of the Pipe Organ," appearing on page 113 of this issue. This is by no means the first time we have turned to that institution for data and illustrative material, and we are pleased to feel that on so many occasions our columns have been the medium for extending the scope of the Museum's exhibits far beyond the limits of New York City.

THERE is no greater hobby than radio. Over 300,000 radio amateurs in the United States alone constitute ample proof of that bold assertion; but if further proof is required, it is a simple matter to point to the many large and small companies engaged in the manufacture of amateur radio equipment. From time to time we have been asked to consider radio seriously, especially the amateur phase, and to inaugurate a special radio section. Candidly, we are much in sympathy with the suggestion, for we have often donned the head 'phones and listened of an evening to the amateur and commercial transmitters in and about New York, with an occasional radio telephone thrown in for good measure. After weighing the matter carefully, we are of the opinion that even with our increased space allotment, it would not be possible to devote sufficient space for a real radio department. We believe there is a sufficient number of journals devoted exclusively to radio for the present needs, but—and here is the point—those journals live so close to radio that they are generally unable to report the big happenings in that field in every-day language for the benefit of the layman. It is our purpose, therefore, to keep close watch on radio developments, and to report current achievements of broad interest. "News and Music from the Air," on page 104, is typical of this purpose.

NO matter what may be the startling changes in this new monthly SCIENTIFIC AMERICAN, one feature stamps it as being of the same bone and sinew as the old SCIENTIFIC AMERICAN—the pictorial comparisons. Many years ago this journal set to work making facts and figures tell their story in picture form, and the "picturized" statistics that have appeared in these columns have been reproduced far and wide by newspapers, magazines, advertising men and others. The railroad comparison appearing on page 85, and the "Leading Armies of the World," on page 96, are typical of that technique. In making these comparisons, the SCIENTIFIC AMERICAN never allows itself to be led astray into the use of "pipe-organ" diagrams, with their mere straight lines of lengths corresponding to the magnitudes to be compared. We always did and always shall follow the pictorial style, where the thing itself is pictured more or less conventionally, the bulk or volume of the figure in three dimensions being usually, though not always, the vehicle of the numerical comparison.

OUR main problem is not so much the obtaining of sufficient SCIENTIFIC AMERICAN material as it is a matter of finding sufficient space. In the preparation of this issue we secured at least 50 per cent more material than we had space for and it was with considerable disappointment that we placed aside certain articles for future issues. But some of this surplus material is a firm foundation for the January issue, which is certain to excel all previous efforts. There is, for example, an excellent review of the rise of illuminating engineering by M. Luckiesh, well known illumination and color authority, which came in just a trifle too late to be included in this issue. The same may be said of Dr. E. J. Loring's article on bombing and bomb sights. Dr. Loring is an Army ordnance engineer who has specialized in aircraft armament. Still another, entitled "A Garbage Crisis," deals with a big problem confronting our large cities. A number of articles crowded out of this issue, but available for the January issue, deal with important engineering undertakings, such as the proposed Belt Line around Jersey City and New York, by Col. W. J. Wilgus, the new Alaskan Railway, the latest flood protection measures in the Miami Valley of Ohio, Philadelphia's elevated railroad, and so on. Dr. Harriss, New York's deputy police commissioner in charge of traffic, has promised to write something for us on the handling of traffic in and out of big cities.

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DECEMBER, 1921

LEADING ARTICLES

SHORT ARTICLES

DEPARTMENTS

SCIENTIFIC AMERICAN PUBLISHING COMPANY

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Founded 1845

CHARLES ALLEN MUNN, President   ORSON D. MUNN, Treasurer
ALLAN C. HOFFMAN, Secretary

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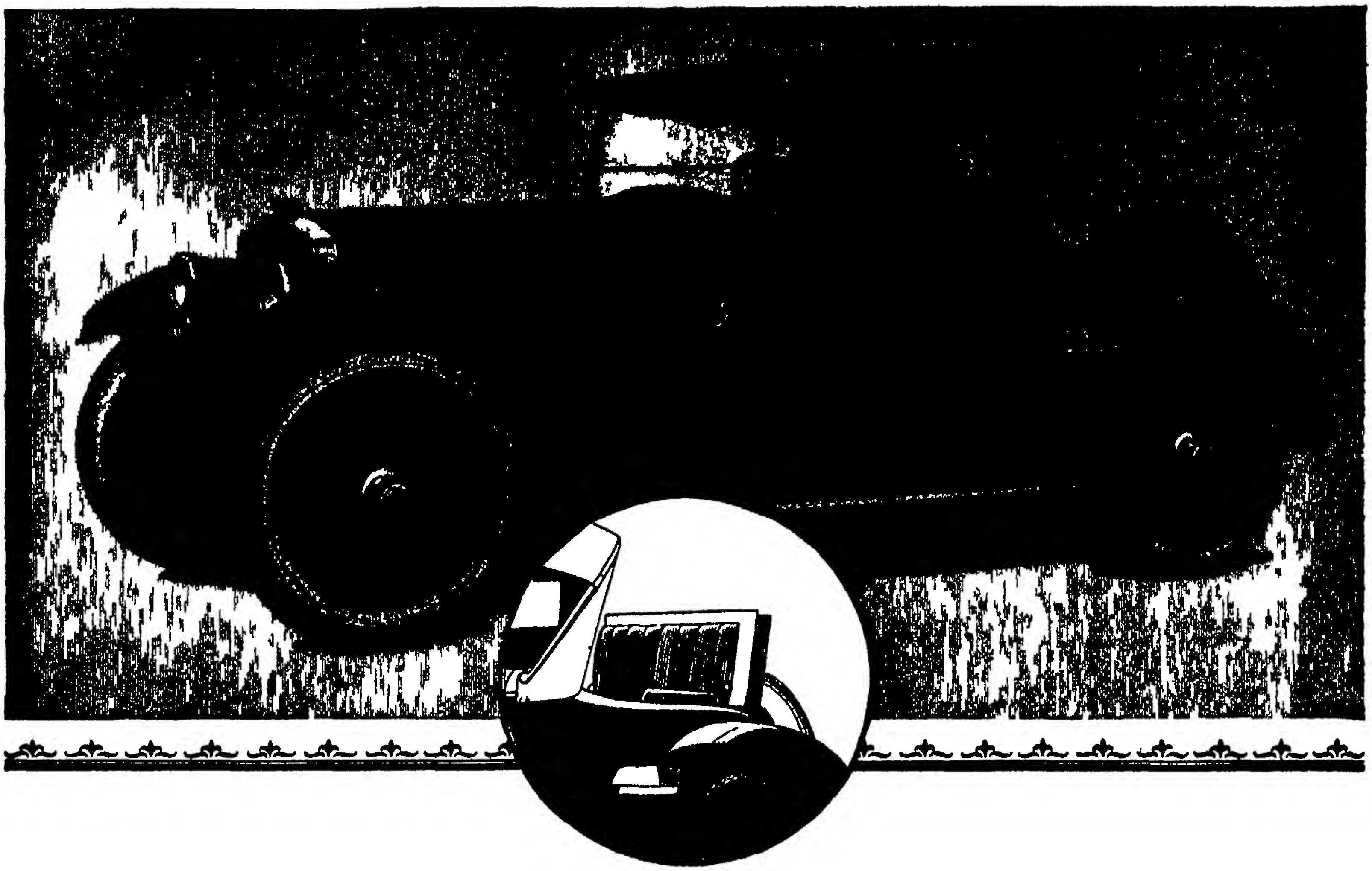
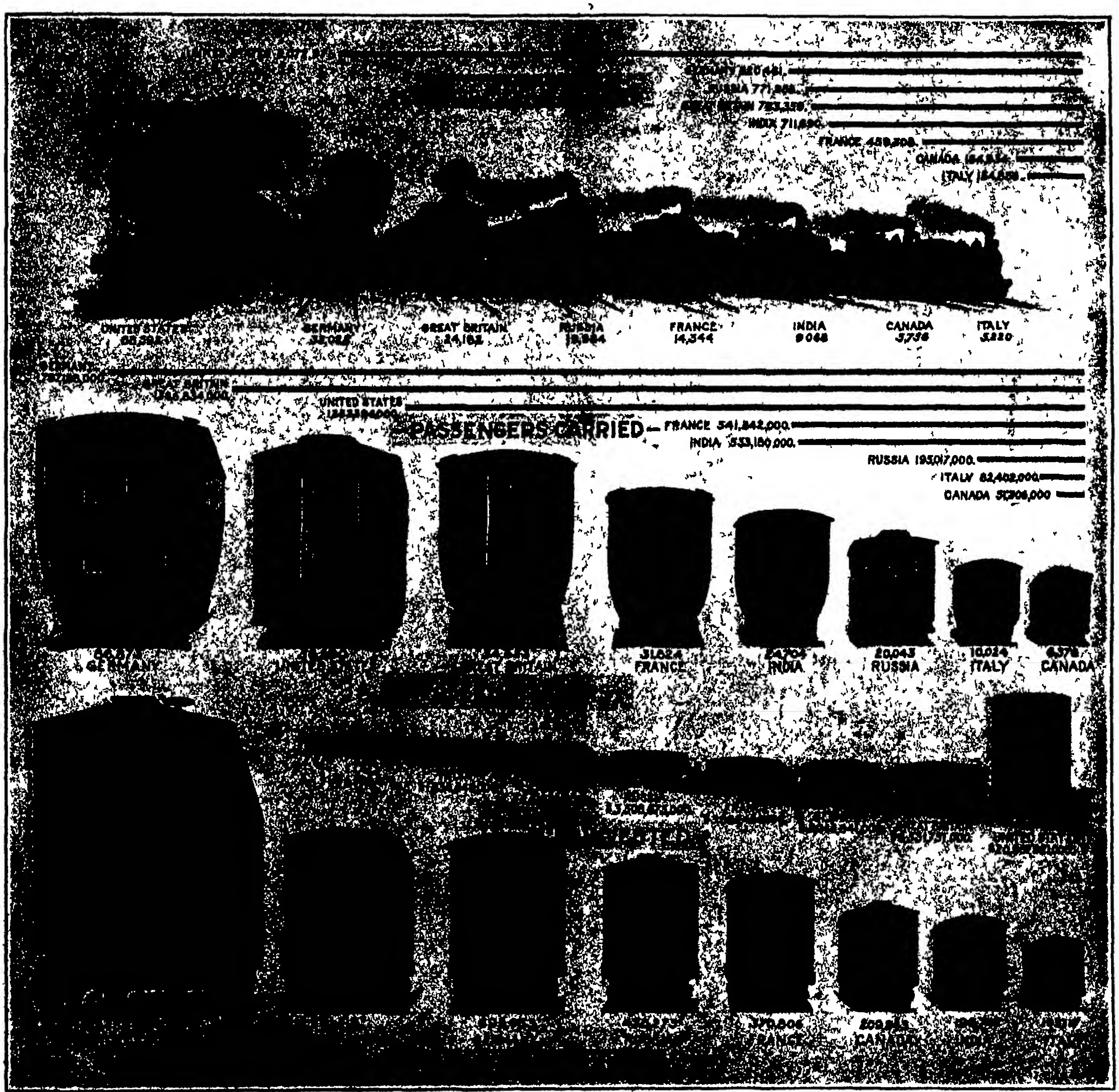


SEVENTY-SEVENTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, DECEMBER, 1921



COMPARISON OF THE LEADING RAILROAD SYSTEMS OF THE WORLD. [See page 91]

Prehistoric Sculpture

An Account of the Discovery of Two Bisons Sculptured in Clay by the Crô-Magnons of 25,000 Years Ago

By Prof Henry Fairfield Osborn

President, American Museum of Natural History

Left Chateau des Fpas, the residence of the Comte de Begouen near Montesquieu-Avantes, Toulouse, France. *Right;* Entrance of the cavern of the Tuc d'Audoubert exactly as it appeared at the time of its discovery when visited by the writer in 1918. Comte de Begouen with his three sons (Les Trois Freres), two of whom are in the small home-made boat in which they entered the cavern.

T IIF prehistoric men of Italy Spain and France sought the great belt of Cretaceous limestone for their shelters for their fireplaces (known in France as *foyers*) for their temples and when the great art period developed for their galleries of drawings and, as this article narrates of sculpture Here were comforts not of our sort it is true but far superior to anything they could create with their hands with the rude tools at their disposal During the last great glaciation the fourth of the series of ice waves from the Scandinavian peninsula and the Alps which swept down over Europe men of the very inferior Neanderthal race occupied the shelters and entrances to these caverns but thus far no evidence has been found that they actually penetrated the mysterious recesses beyond the entrance These mysterious and even perilous recesses were frequented by the cave bear while the Neanderthal race was at its height

When the artistic and courageous Crô-Magnon race entered Europe they not only drove out the Neanderthals and took possession of the shelters and caverns but they soon began to penetrate the innermost labyrinths of the caves themselves not apparently for prolonged residence although fireplaces and small deposits of flints frequently occur deep within the caverns but for development of their art Limestone walls worn smooth by subterranean streams attracted the artists for engraving with flint and for painting first in black and then in several colors All this art is the work of one race very superior in endowment and with keen powers of observation and undoubted love and admiration for the beauty of animal life Having now personally examined hundreds of drawings and paintings in the deep cavern recesses of France and Spain I feel that I am quite justified in attributing these unusual faculties to a race that existed between twenty five and forty thousand years ago

About thirty of these art caverns have been found in France and Spain containing drawings, engravings flint etchings and paintings but not a bit of sculpture This exception was suddenly removed early in the year 1914 by the discovery of two bisons sculptured in clay in an art cavern in the central Pyrenees in the heart of a small limestone mountain on the property of the Comte de Begouen, from the top of which one can see the whole central range of the Pyrenees

In 1913 I happened to be near Saint Girons in the Pyrenees two days after the discovery of this new cavern which received the name of the Tuc d Audoubert The discovery was made by the sons of the Comte de Begouen mere striplings at the time who had secured from their father permission to build a small boat in which they might paddle up the stream which flows from the entrance to the cavern About two hundred feet from the entrance they found a limestone wall ten feet high and clambering up they found the entrance to the cavern Returning for an acetylene lamp the boys explored the side walls, on which about three hundred feet from the opening they perceived a number of flint engravings They hurried back home and communicated their discovery to their father who hastened to the spot, and thus another cavern was added to the long list of those which have been made known by French archaeologists Two days later I happened to arrive accompanied by Professor de Cartaillac of the University of Toulouse. With characteristic French courtesy the Comte de Begouen insisted upon our being the first to enter the chamber in which the new drawings had been found This memorable experience is described in my Men of the Old Stone Age

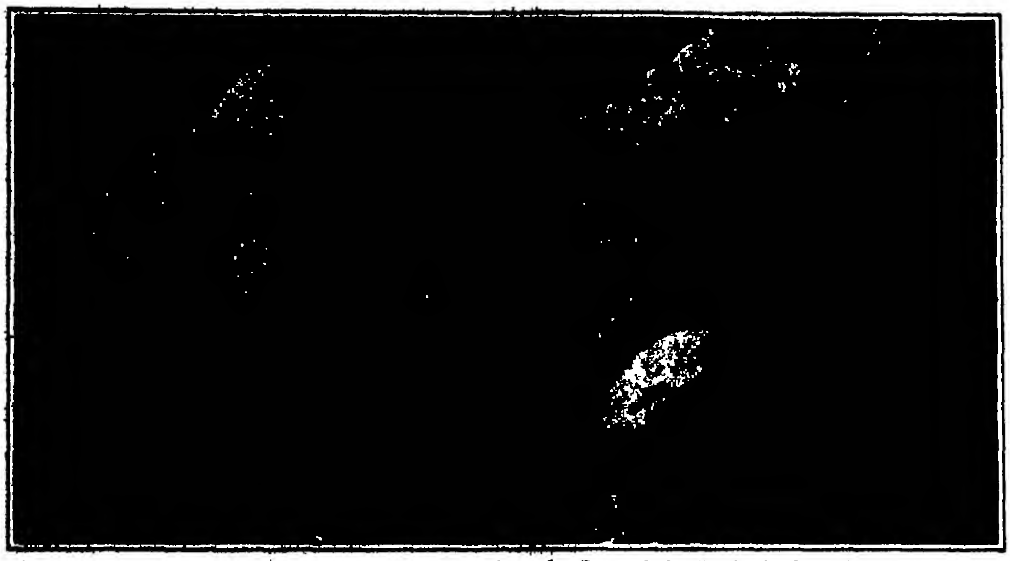
The original cavern was thoroughly explored and found to contain a few interesting etchings but nothing of very great importance A year later however just before the beginning of the war the sons of the Comte discovered a very small opening leading upwards—an opening so narrow that it barely permitted the passage of the body even of their small frames. They pursued their upward sinuous course crawling like salamanders on their faces and pushing their acetylene lamps before them through passage after passage, until finally they reached a large chamber about fifty feet long and thirty feet across with ceiling about twelve feet in height At the end of this chamber they found indications of a circle within which were the models of two bison, bull and cow lying partly on the side. The models were in clay as fresh as when they left the hands of the primitive sculptors twenty five or thirty thousand years ago This absolutely unique discovery astounded all the archaeologists of Europe The chamber was termed the *salle des bisons* and soon after its discovery was visited by two leading archaeologists of France, Professor de Cartailhac and l'Abbé Henri Breuil.

Last summer I had the first opportunity of seeing this *galerie supérieure* myself, accompanied by the Comte de Begouen, for in the meantime the three Begouen brothers have grown up, served with distinction in the World War, and have entered on their various careers. Our party consisted of the Comte, now of portly figure, two daughters of M. Lalanne, the archaeologist of Bordeaux, William Williams, former Commissioner of Immigration of the Port of New York, and myself. We entered the cave, each provided with an acetylene lamp and dressed in a miner's suit. We ascended a very long, narrow and difficult passage, with constantly interesting illustration of the archæ-

Interior of the Tuc d'Audoubert This is the "Salle Cartailhac," named in honor of Prof. Emile Cartailhac, who first explored this cavern with the writer. (Photograph by permission of Comte de Begouen)

and physical courage of the Comte and other French archaeologists which led them to explore this passage before any of the iron ladders, steps, and other aids to the ascent were prepared to facilitate the work and before certain obstacles in the narrow passages were removed. Even now the ascent is extremely arduous and one arrives at the *salle des bisons* in a profuse perspiration but in a frame of mind ready to contemplate one of the greatest wonders of prehistoric art.

Each bison is about eighteen inches in length. The characters of the male and female are clearly indicated. The tool work is still fresh, and as the acetylene light is passed slowly around the sculpture one observes that these bison are two masterpieces, done in a very broad modern style, with absolute truth of proportion and truth of mass. Nearby is a third partly finished bison and a model of a fourth which may have been carried into the cave to aid the sculptor. Ten feet away are several rolls of fresh clay, indicating that the clay was carefully worked with the hands before being applied to the modeling process. The models themselves give the impression of having been carved out of a solid block of clay, with the addition of certain parts, like the tail, horns and mane, from the rolls of clay nearby.

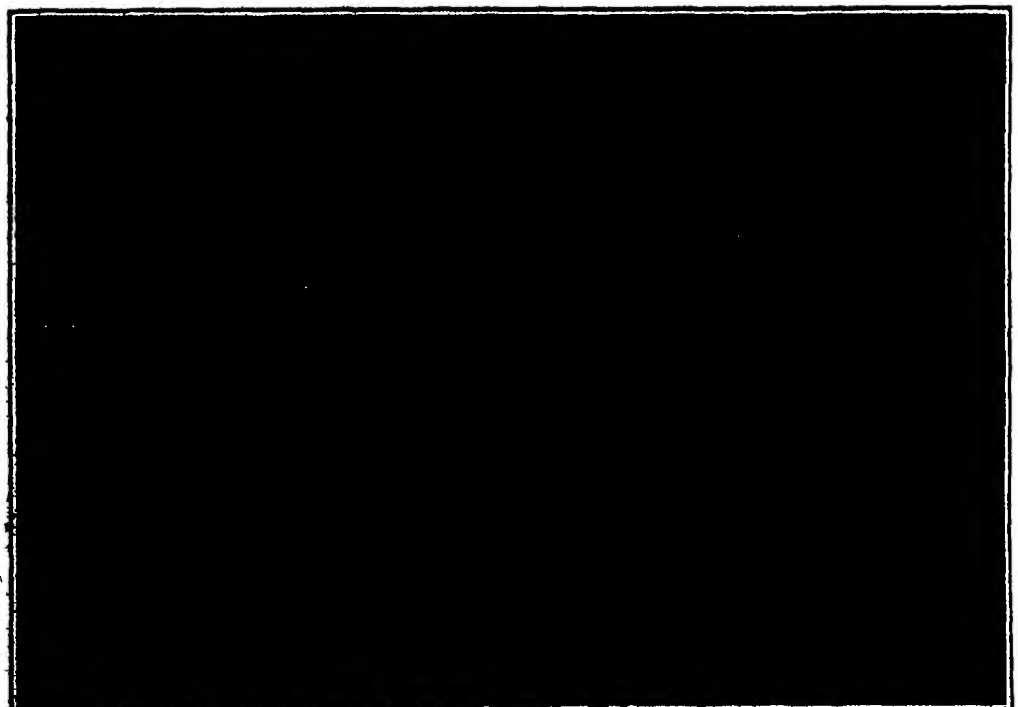


The two bisons sculptured from the red clay found on the floor of the "salle de danse" in the cavern of the Tuc d'Audoubert. Left-hand figure represents a male, the right a female, bison. The models are supported by a central mass of clay exactly as they were left by the sculptors about 25,000 years ago. (Photograph by permission of M. Jean Brunhes)

About twenty-five feet away is a small depressed chamber called the *salle de danse*. Here are fresh hand and foot impressions, slightly coated with drippings from the limestone ceiling above. A number of heel marks are perfectly preserved, and the Comte de Begouen insisted on raising one of the natural casts of this heel of, perhaps, an ancient sculptor as a gift to the American Museum of Natural History.

No language or description can possibly convey to the mind the mysterious impression given by the chamber itself. One is overcome by the mystery of the great antiquity of the human sense of intelligence, of the human appreciation of art, perhaps of the religious sentiment which animated these sculptors of the Crô-Magnon age and inspired them to penetrate the deepest recesses of these caverns with very feeble lamps. The motive of sculpture may have been in a sense propitiatory to some superior power or divinity. This at least is the prevailing theory, which is strengthened by the discovery of a large chamber in a neighboring cavern which has received the name of *Les Trois Frères* in honor of the three sons of the Comte de Begouen who discovered it. Within *Les Trois Frères* the chamber is fairly covered with mural engravings. Every available foot of space has a design upon it, and in one corner of the ceiling is the figure of a sorcerer, or medicine man, not entirely dissimilar to the dancing figures found among some of our Indian tribes of the West, the head provided with horns and the back covered with the pelt of an animal, perhaps a wolf, from which is suspended a tail.

We have not the space to describe *Les Trois Frères* at greater length, but in the accompanying photographs the reader may see the entrance to the cavern of Tuc d'Audoubert, the two sculptured bison as they appear, and the etching of the figure of a horse in *Les Trois Frères*. This etching of the horse is highly characteristic of the [illegible] of the Crô-Magnon [illegible]. The original [illegible] limestone wall is covered with a brownish tint deposit from the muddy waters of the stream which made the cavern. In order to represent the light natural coloring of the hair of this species of horse the artist, after sketching in his outline accurately, scratched off the brownish coating, exposed the light-colored limestone beneath, and thus portrayed with remarkable fidelity the light coloring of the under parts of the body which is observed in all species of wild horses. The greater number of drawings in the Caverne des Trois Frères are really etchings, executed by removal of the dark coating on the limestone walls, exactly as an etcher works today. We are indebted for permission to publish these photographs to the Comte de Begouen, who referred the writer to a forthcoming paper by one of the leading French archeologists, l'Abbé Henri Breuil, for authentic description of the numerous etchings of many kinds of animals—horses, rhinoceroses, mammoths, reindeer, stag, cave bear—found within this remarkable cavern.



Recently discovered etching of the small Celtic horse (Equus caballus celticus) of the period, in the Caverne des Trois Frères. (Photograph by permission of the Comte de Begouen)

Precision Test of Large Capacity Scales

THE accuracy that can be obtained from large weighing scales is not generally known among engineers and others concerned in the subject. This paper outlines a scientific and systematic procedure for the accurate test of large capacity compound lever scales, by a method which has been developed and used by the Bureau of Standards, largely in connection with its work in testing railroad master track scales, and grain hopper scales, but the plan can be adapted to the test of almost any compound lever scale.

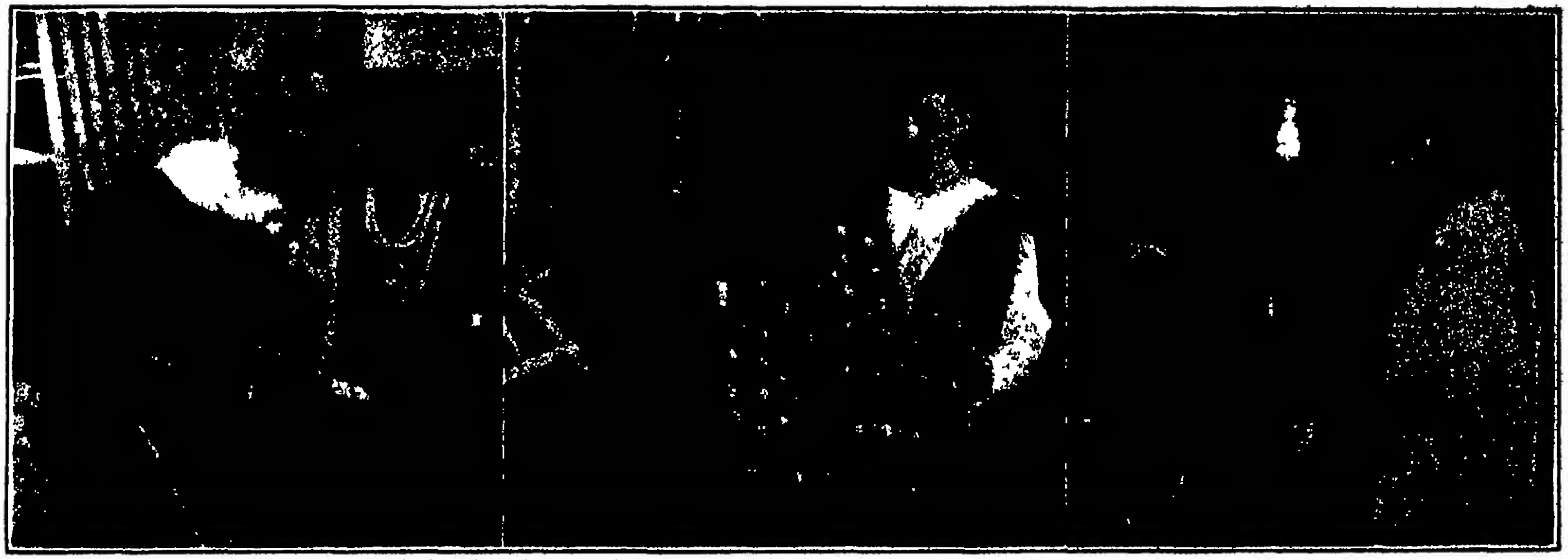
A pointed and graduated scale is arranged for reading the position of the beam, and the errors of the scale are determined from observations made upon the beam while it swings freely. The method of recording data and of determining the results is very similar to that which has been in use in laboratories for precision weighings on fine equal-arm balances. The method of taking and recording the data also tends to eliminate the personal equation, to point out where mistakes are made, when such occur, and gives a very complete record of the test which will present very understandable and detailed information to any one who has occasion to make a critical study of the test.

The method is not suggested for use in the regular routine testing of ordinary compound lever scales, where precision results are not required. The method given here requires the observance of certain details consistent with realizing precision, and requires training and ability to a greater extent in those making the test than is required in the ordinary case.

The procedure of the test is explained with the aid of a record form and computation sheet which was developed in connection with the successful application of the method in the field. In the interest of a uniform and efficient method the scheme outlined is recommended to those who have occasion to carry out tests on large scales where accuracy of a high order is required.

The Production of Liquid Air on a Laboratory Scale

THE essentials of a plant producing liquid air by the Hampson process are the compressor, purifying train and liquefier. The compressor, usually of four stages, delivers air at room temperature and approximately 3000 pounds per square inch. The compressed air purifying train consists of first, a trap for receiving oil and water, and secondly, suitable containers which are charged with chemical reagents, such as sodium hydroxide, calcium chloride, or lime, for removing carbon dioxide and water vapor. The air thus compressed and purified is delivered to the liquefier, in which, after passing through a coil of copper tubing, the air is allowed to expand freely to approximately atmospheric pressure. Where this drop in the pressure takes place there is a corresponding drop in the temperature of the air. The expanded air, before leaving the liquefier, is caused to circulate around the copper coil which contains the compressed air, thus cooling the coil and, in turn, the compressed air so that on continuous operation a cycle of progressive cooling is maintained until the temperature ultimately reaches the liquefying point. The liquefier is so constructed that the air which is condensed to liquid is delivered into a receiving vessel. The gaseous air exhausted from the liquefier is returned to the intake of the compressor for succeeding cycles because it has been purified, and when used repeatedly will be less exhausting on the purifying reagents. For laboratory production of liquid air this process leaves little to be desired.



Left: Metallurgist using a micrometer on infinitesimal particles of metal in the Schenectady laboratory. *Center:* Studying the crystalline structure of matter The instrument on the bench is an X-ray camera for photographing structural features; the model is of a complicated crystal. *Right:* Testing high-power radio tubes

Three widely divergent activities of the Schenectady laboratory

The Rôle of Research

Creating New Things and Revising Old Things for the Industrial World

By W R. Whitney, Ph.D.

Director, General Electric Research Laboratory

WHAT must America do to establish itself as the leader among nations in making natural forces do the world's everyday physical work?

This is not an academic question We are in competition with others for world trade. The premiership will go to that nation which excels in learning how natural forces may be utilized in the continually expanding tasks of mankind, and in turning out the best devices for using those forces.

Shall we content ourselves with being only a nation of artisans carrying out the ideas of others, embodying the results of their discoveries, or shall we be leaders in new undertakings and in general advance? And if we aspire to excel in this field, what is necessary for success?

The principal essential is a body of trained investigators.

At first sight this may not be perfectly evident We may not realize how much we depend on new discoveries. Unless growing we cannot live. The world is so constituted that the undertakings of one period are insufficient for the later one. Experience has shown us that even if we might exist like Islanders of the South Seas, it can never be generally done It has instead, shown that our happiness, measure as we will, is extended by further efforts to appreciate things about us, to understand creation. Nowadays what most of us are doing depends upon some phenomenon or property of matter unknown a century ago which has now become a pillar of civilization Only a few till the ground and work without modern tools. What most of us think and talk about, what most of us depend upon for our living, growing and playing, is the result of study recently added to study formerly expended We start the day with a tempered bath, forbidden by law less than a century ago, because they didn't know its value We use all sorts of devices for shaving and improving our health or appearance before we dress, and we are only interested in the most modern materials and styles for clothing We breakfast on products derived from the most distant sources and prepared in entirely novel ways. We go to our work in a device unknown to our grandparents, whether it be train, street car or auto, and we spend our day working on something of which the vocabulary itself was not invented a few years ago. We dictate, telephone, telegraph and turn on and off the power for machines which represent a hundred times the physical strength of all the people together The coal, the water and the gas are more necessary to our physical and mental make-up than wheat and corn. The more we have, the more we want, and nature encourages this rule by making every contribution to truth, about rearrangements of our surrounding materials, a manifold contribution to our horizon and our happiness. There is evidently no upper limit, what limit to improvements may exist is in us, not in the externals which we employ Thus the trained investigator is like the successful pioneer, who, in the days of unopened territory, led the people to fertile home sites.

We have the other requisites. We have splendid laboratories. We have a wealth of materials with which to work As a whole, we have abundant money for carrying on such work But we must have competent men to use them.

A vast majority of the men engaged in research work today are college trained. Those of the future will probably be college trained. Hence, if we are to develop such a force as we must have in order to lead the world, the colleges in which they are educated will be the means for developing it.

If our colleges were today doing this to the maximum extent, there would be no question about our leadership. Hundreds of students are being graduated from scientific and engineering courses in American colleges and universities every year It is not quantity that we lack. The call from existing industries has thus far demanded the quantity.

What are the necessary qualifications for research work?

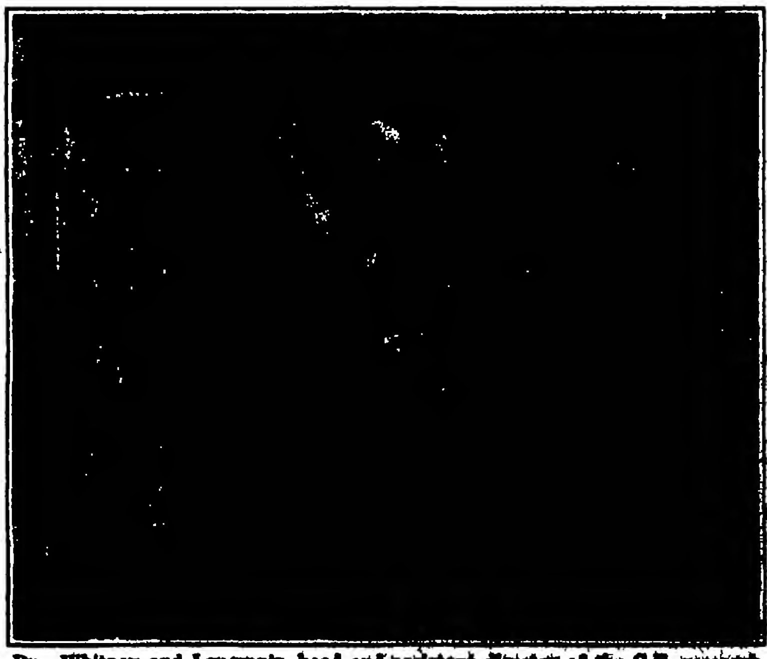
Among them are interest in unknown things, imagination, persistency, ability to distinguish between what is essential and what is not essential Ingenuity is an important asset, as is also resourcefulness. The research worker must know facts about matter—call it physics, mechanics, chemistry, electricity, or what not. The more he knows about his own science, other things being equal, the more he will accomplish, and the broader his knowledge of other sciences, the greater will be his ability

Without inquisitiveness, initiative, and thorough ground work of knowledge in their chosen line, research men will make little progress. Research is really 90 per cent hard work—work of the most exacting, strenuous, exciting, but often disappointing sort, and if the men now in training for the further advancement of the boundaries of human knowledge along the line of doing the world's industrial work are to succeed, they will have to toil as they dream.

The research worker must be alert to recognize the magnitude of a discovery he may make even though it is useless for the particular purpose for which he sought to use it. For instance, Dr. Irving Langmuir, seeking to learn how oil spreads on water, discovered how to measure the size of molecules. He must be patient It was at the end of ten years of experimenting that Dr W D Coolidge learned how to make tungsten ductile—a discovery that has revolutionized the making of incandescent lamps.

America possesses ample material from which to develop research men excelled by none. But what about their training? Is the college of today doing its part in this development? Is it training investigators, or merely turning out human scientific and engineering data collections—minds full of information gathered as the result of the research of others, but without the interest or the training to make it the basis for investigation on their own part?

We need more college professors who do not merely impart a certain amount of scientific information to their students. We need teachers who themselves are investigators and who are a source of in-



Drs. Whitney and Langmuir, head and assistant director of the G.E. research, and its guiding spirits

spiration as well as purveyors of knowledge, who are not content to give their pupils merely the results of the attainments of scientists of the past, but who are themselves experimenting to learn new scientific truths, and who encourage their pupils to experiment. Such teachers are and should be relatively expensive for they are rare and complicated.

Would it not hold the interest of the boy in college in the work of his course if he could get his hands into real experimental work with a professor who was earning $25,000 a year on some pioneer work? If he assisted in experiments on alloys of magnesium with chromium, for example, and saw the promise of light-weight airplane metals or platinum substitutes, for example, might not even the trite burning of magnesium interest him? Might not helping in real investigation work convince him that he is on the right track so far as his education is concerned and that his best application to his college work is well worth while? If the importance of experimental work as the promising avenue to the successful completion of a worth-while quest were more strongly emphasized, might he not naturally come to value and to practice inquisitive patience?

Our colleges equip their graduates in science and engineering with a mass of technical information, which is certainly desirable. Without it, the most interested and ambitious research man feels mentally cramped. But they rarely leave them with even that natural inquisitiveness and general interest with which they first entered college.

The methodical accumulation of old facts by its apparent economy in teaching makes the student dread the greater expenditure necessary for production of new information. It is as though a halo surrounded ancient data for which attempts to produce new or different knowledge was anathema. Some such reason may account for the decrease in inquisitiveness discernible in maturing youngsters and the undue reverence for old truth. There is a difference between the acquisition of knowledge and its production. We may acquire more than any other country, but we produce relatively little of it yet.

We need more men of outstanding eminence in the scientific world in college professorships. How shall we get them? One thing that would help would be better salaries—salaries in keeping with the importance of the work. Another would be such an increase of the teaching force as to take more and more of the mere routine or executive work from the shoulders of the department head if he is a man fitted for research.

Might we not gain by so increasing the requirements of the scientific and engineering courses as to weed out aimless and ambitionless students, and thus lighten the task of the teacher? Would there not be a gain in the case of the smaller college, at least, if the number of students in such courses were limited to a definite maximum?

It is a great opportunity. It is because of successful labor in the field of research that today men ride in ease and comfort from New York to San Francisco in a few days instead of making a hazardous journey of months on foot or on horseback. The man in Duluth closes a business deal with an associate in San Antonio by speaking into a telephone transmitter, instead of making a long and wearisome trip. We may fly over land and sea at amazing speed in aerial vehicles, or we may ride beneath the surface of the waves. At a snap of a button the house is illuminated, at the throw of a switch the myriad machines of a great factory begin to turn. From the woman released from the thrall of the washboard by the washing machine, to the statesman who averts war by a radio message hurried across the sea, all are in debt to research, but we are poorly organized for this work.

Wonderful as the achievements of the last half century seem, the scientific terra incognita is by no means mapped. Indeed, we have not penetrated very far into it. There are possibilities of wonderful discoveries there.

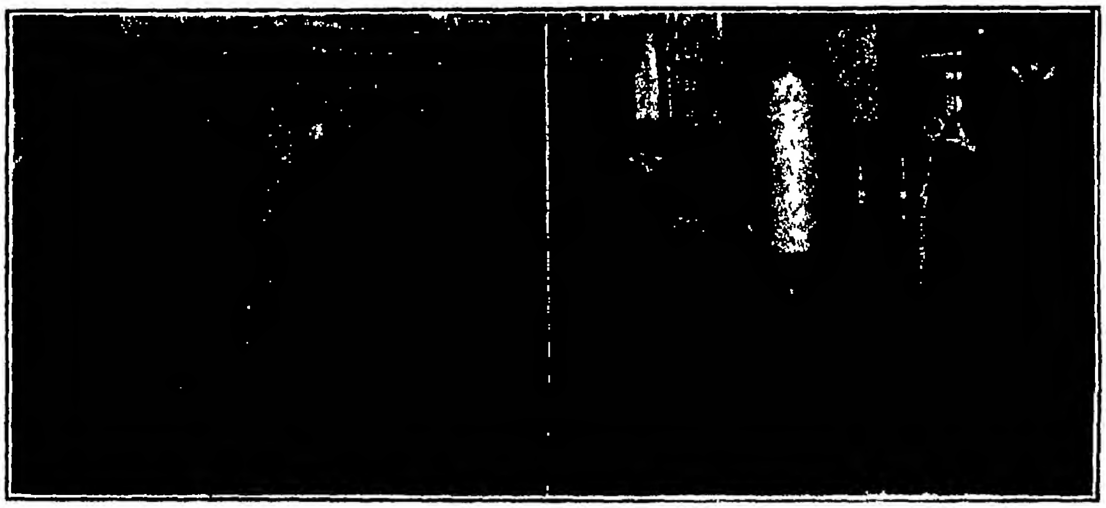
And it is work which promises something infinitely better than mere selfish gain—though there are, to be sure, personal rewards of a most satisfactory kind incident to it. It is a work of service to mankind for which most men have an impelling instinct.

In serving mankind, Americans will be serving their own people, not merely through making it possible for them to do more work, to do better work and to do it more easily, but by making them teachers of the rest of the world. Science applied to industry is creating new demands. It is resulting in calls for machinery never before built. Hence it is originating new fields of employment and new utilizations of raw material, with all that this means to industry and to the employment that runs parallel to industry.

Shall we not lead in this field, and to do so shall we not train men who will make such leadership possible? It is a great opportunity that presents itself to America—great in the possibilities it offers for advancing its own immediate interests, and for promoting the welfare of mankind.

In chemistry we are seeing today a wonderful illustration of the value of the policy of suitably supporting far sighted research, the simple acquiring of new knowledge. Our newspapers are full of discussion of the dye embargo. They find that our weakness in this chemical field bears very heavily on all parts of industrial interests. Fertilizers for the farmer and ammunition for the Army and Navy, benzol and new synthetic auto fuels, the thousand and one organic compounds used in medicine, war gases and an endless list of related materials hail from Germany. England, France, Japan and Italy have already shut out German dye stuffs. As the key to the situation, America must do likewise. This is advisable, not merely for the protection of the relatively small industry—artificial colors, but for the protection of the whole future of many lines of chemical industrial development.

How did Germany happen to occupy this powerful situation, from which the greatest war-failure ever suffered has not been sufficient to remove her? She had employed for years highly educated pure research men working in, and teaching organic chemistry. This was before the first artificial coal tar color was produced, or any technical applications in sight. Every one of twenty Universities was the center of some branch of organic chemical research where an able man was making it his entire life-work to add to the knowledge of his branch. Lecturing was only a part, frequently a very minor part of his work. His students came to him because he was a great worker. They each spent a year or two (sometimes much more) working out some purely scientific non-commercial organic analysis or synthesis for its educational value. Many thousands of new compounds were thus made and their properties learned, published and cataloged. It had been found that substances once thought to be produced by life alone were producible in the laboratory, and that countless compounds never produced before could be synthesized. This opened an infinitely long vista to chemists. Looking back upon this policy of pure research, it seems very far sighted. In fact there is on the horizon no other tested method insuring the advancement of a country which compares at all with that of the combination of intelligent, inquisitive orderly searching, combined with teaching, whether it be for art or industry.



Left: The hottest spot in Schenectady: inserting a bar of metal into the molybdenum furnace at about 5000 degrees. *Right:* At the other end of the scale—liquid air at 310 degrees below (Fahrenheit)

Temperature extremes in the G.E. laboratory

America's First Model Airway

THE establishment of America's first model airway—linking the headquarters of the Air Service of the United States Army at Washington, D. C., with its engineering division at Dayton, Ohio—is considered the initial tangible effort to develop both commercial and military aeronautics in a national way. The proposed plans call for the location of landing fields, and the erection of hangars by the municipalities deriving benefits from the organized air navigation.

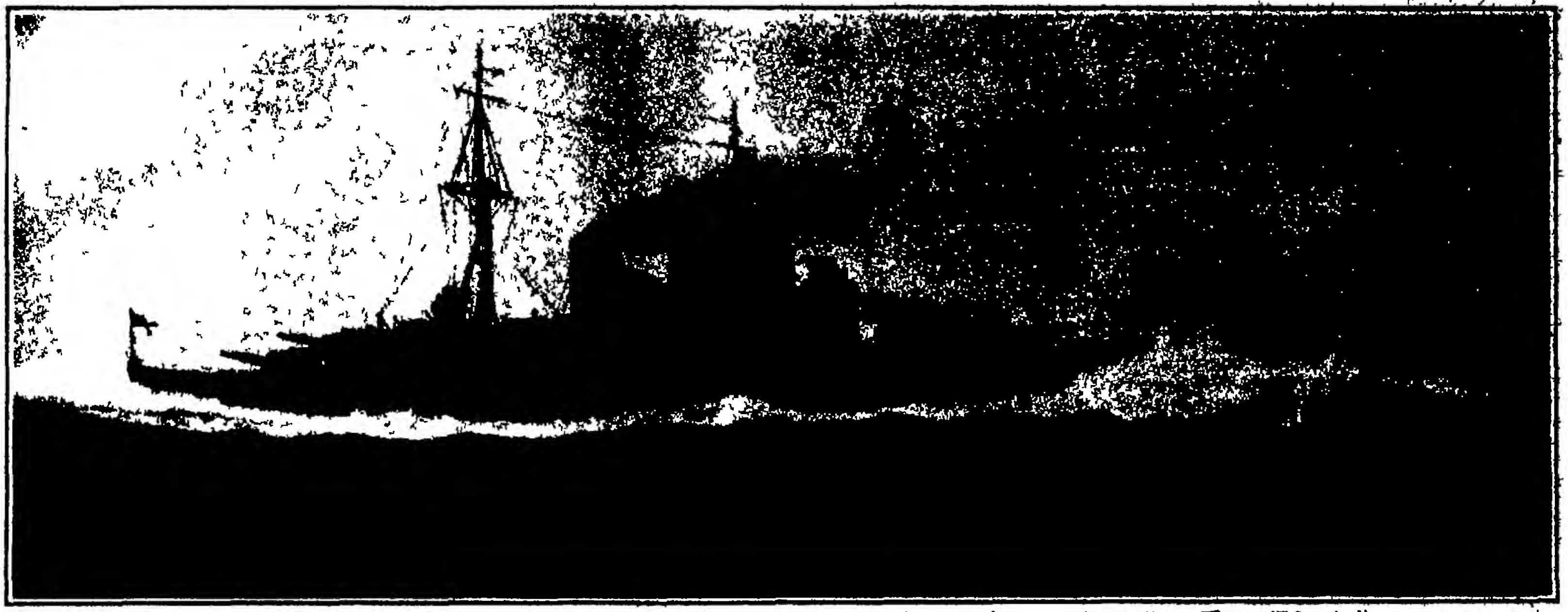
Ultimately, anticipating the success of the Washington-Dayton air line, the country will be threaded with a network of well-defined routes for air going machines. The units of the National Guard and the organized reserve will find these highways of the air a base for operations. The Air Service, however, disclaims any intention of usurping the system, but travel, under legislative restrictions, will be open to commercial aeronautic interests.

The Boy Scout organization has been enlisted as an agency to place markers as means of identifying the various towns over which the model airway will course. This youthful organization was instrumental in laying out the landing field identification at Bolling Field, Washington. The Chief of the Air Service in writing the mayor of Cameron, West Virginia, says: "In the first place it is necessary to have every town along the route of any size marked according to an international system so that the aviator going from one part of the country to the other will know at a glance, even without the aid of a map, his approximate locality on the earth's surface. The dimensions of this mark and instructions with regard to it will be found in the instructions to Chambers of Commerce and Boy Scout organizations attached herewith."

The first unit in the proposed systematic chain of airways for the entire country is typical of conditions that will be encountered elsewhere. Mountains are to be passed over, and the climatic conditions are variable. The Washington-Dayton line will serve as a basic guide for the contemplated expansion of military and commercial aviation. Cities and towns, favorably situated, are being urged to establish landing fields. If this is not feasible, then an emergency field is suggested for the reception of the aviator should he experience engine trouble or other aggravating circumstances, rendering it advisable to bring the machine to earth.

The Air Service of the United States Army is unable to purchase land or provide expenses incidental to the creation of the model airway, but can supply such equipment as is available for insuring the establishment of the route. The municipalities, civic organizations, and individuals will be necessarily taxed with the actual creation of the navigation route. Writing to a mayor in a nearby town, the Air Service says: "Attention is invited to the fact that Congress has not appropriated any money for the purchase of property for this purpose, and while, in some isolated cases, the Air Service may lease a field at a nominal sum to enable it to erect temporary structures and install a radio direction tower or station, it will not be advisable or necessary to own or lease all the possible fields. Natural landing places, such as pastures, could be kept in shape by Boy Scouts of the community and would be an exceedingly valuable asset to the Air Service if charted on our airways. Those towns and cities that provide these will always be kept in touch with the passing airplane traffic."

Cross-country flying and flying by night will be stimulated by a completion of the Washington-Dayton air-line. Other than landing fields, the plans contemplate radio direction finding, wireless communication, aids to night navigation, housing and maintenance of equipment. Information and advice relative to landing fields, radio apparatus, hangars, and other specifications incident to the creation of the airway will be supplied by the Army Air Service. This service may include the detailing of a qualified officer to superintend the work.—By *S. R. Winters*



Great Britain has authorized the construction of four battle cruisers, whose general design is shown in the above illustration. They will be similar in appearance to the "Hood," from which they will differ in having a more powerful armament and heavier and more complete armor, at the cost of lower speed. They will mount ten 16-inch guns and will have a sea speed of about 29 knots

Britain's New Battle Cruisers

Some Particulars of the Four Big Ships of the British Program

By Hector C. Bywater

EARLY in September the Admiralty invited bids for the construction of the first four capital ships which have been authorized for the British Navy since 1916. They are officially described as "replace" ships, and before they are placed in commission at least eight of the older dreadnoughts will have gone to the junk heap. It is understood that tenders for the hulls, machinery, and equipment of the new ships have already been submitted by the leading shipbuilding firms, and an early announcement as to the allocation of the contracts is expected. In former times it was the custom to allot one big ship of each year's program to the Royal dockyards at Portsmouth and Devonport, respectively, but this was impossible in the present instance because the building slips at these yards are not large enough to take vessels of such colossal dimensions as those of the post-war capital ship. Consequently, all four units are to be built by contract, and in view of the uncertain state of the labor market and the fluctuating price of materials it is not improbable that the work will be done on a cost-plus-profit basis.

Battle Cruisers with Heavy Armor

Up to the present only the meagerest details of the new ships have been published officially, and the Admiralty shows no inclination to disclose further particulars. But from hints dropped in the House of Commons during the recent debate on the Navy Estimates and from various statements made in well-informed quarters it is possible to visualize the essential features of the design. Although they are officially designated battle cruisers, the new ships will be slower than the "Hood," but they will have thicker armor and a much more powerful battery. They may therefore be taken as representing a virtual amalgamation of the battleship and battle cruiser types, a course which has been strongly urged by British naval officers with war experience.

The striking lessons of the late war have, indeed, profoundly modified the British estimate of tactical values. Ten years ago there was a veritable craze for speed, and in order to gain an extra knot or two hitting power and protection, but especially the latter, were cheerfully sacrificed. Several of the British battle cruisers with the Grand Fleet carried thinner armor plating than that of the German pre-dreadnoughts, and their sides were penetrable by heavy-caliber shell at almost any effective range. Furthermore, weight had been saved by thinning down the armor on turrets and barbettes, and by fitting horizontal protection that could offer no serious resistance to heavy blows.

Ten-Minute Ships

Even before the war the vulnerability of these ships was well known in Germany. Admiral von Tirpitz dubbed the "Invincible" class "Fisher's ten-minute ships," thereby implying that they would succumb to attack by gunfire in ten minutes. Jutland unhappily vindicated the accuracy of this German estimate. The *eggshell* doctrine, initiated by Lord Fisher, found its most striking expression in the battle cruisers "Renown" and "Repulse," built during the war. These ships were fitted with narrow belts of 6-inch armor, and when they joined the Grand Fleet at Scapa Flow Admiral Jellicoe, realizing their fatal weakness, refused to incorporate them in his battle formations until they had been taken back to dockyard and fitted with thicker plating over vital parts. Since the war the "Repulse" has been partly reconstructed, and in place of her original belt now has a deep girdle of 9-inch armor. Also, the anti-torpedo bulge has been broadened and deepened—changes which have increased her fighting efficiency by 50 per cent. Her sister, the "Renown," will undergo a refit on similar lines when opportunity offers.

Improving on the "Hood"

In the "Hood," which was designed before the Battle of Jutland, but not actually laid down till afterwards, an attempt was made to embody the lessons of that action by increasing the armor belt from 8 to 12 inches and the barbettes from 9 to 12 inches, involving an additional weight of nearly 5000 tons. But the "Hood," after all, was a compromise, and has been explicitly repudiated by the Naval Staff as a genuine post-Jutland type. They consider her design to be wasteful in that it allows a battery of only eight big guns on the enormous displacement, at full load, of 44,600 tons, and they are not satisfied with her protection against flat trajectory and high-angle fire. All these faults are to be remedied in the new ships, the plans of which have probably received more attention than was bestowed on those of any previous unit of the Royal Navy. Briefly stated, their salient characteristics are, a numerous battery of 16-inch guns in triple turrets, side armor proof against perforation at long range, and very stout horizontal protection, moderate battle cruiser speed, but a very extensive cruising radius, duplication of controls for every important element of the maneuvering, gunnery, torpedo, and signalling organization. The following data, not being official, must be accepted under reserve, but they are believed to be substantially accurate: Length over all, 856 ft.; extreme breadth, 104½ ft.; mean draft, 29 ft.; normal displacement, 48,500 tons. How many 16-inch guns will be mounted is not definitely known, but alternative arrangements of ten guns in two triple and two double turrets, and twelve guns in four triple turrets, have been suggested. The machinery will be geared turbines supplied by small-tube boilers, the plant developing up to 125,000 shaft horse-power. According to this figure the maximum speed will probably be about 29 knots. The proposal to equip one ship with the electric drive has been rejected, as this method of propulsion is not viewed with favor by British naval engineers. The machinery will account for about 9.5 per cent of the total displacement, as against 13 per cent in the "Hood." This fact is significant of the diminished value now attached to speed by the controllers of the British Navy. The oil stowage capacity will be sufficient for a run of 10,000 nautical miles at economical speed, enabling the ships to steam from England to Hong Kong without refuelling. No details of the armor system are accessible, but it is known that valuable pointers were obtained from the firing experiments at the ex-German battleship "Baden" last March and from several other tests conducted in the past twelve months.

Why the 18-Inch Gun Was Rejected

From the gunnery viewpoint the most interesting feature of the new ships is the introduction of the 16-inch caliber, which is new to the British Navy. Some thirty years ago a 110-ton piece of 16¼-inch caliber was mounted in a few ships, but was eventually discarded on account of its abnormal weight and slow rate of fire. Why the 16-inch gun should have been adopted at this stage is something of a mystery to the uninitiated, considering that the new mark of 15-inch mounted in the "Hood" has proved to be a thoroughly satisfactory weapon. But the explanation is simple enough. The Naval Staff, presided over by the First Sea Lord, Earl Beatty, is said to have been in favor of mounting 18-inch guns in the new battle cruisers. Guns of this caliber were actually made during the war and displayed magnificent ballistic qualities both on the proving ground and in action against the German positions on the Belgian coast. The monitor "Lord Clive," armed with a single 18-inch gun, made accurate shooting at 42,000 yards, and on the eve of the armistice this vessel, together with another monitor similarly armed, was preparing to bombard Bruges at a range of 80,000 yards. All who have seen the 18-inch gun at work are in agreement as to its fine properties. Notwithstanding its great weight—150 tons—it can discharge one round per minute, and its accuracy at all ranges is far superior to that of smaller caliber

(Concluded on page [illegible])

The American public has learned all these facts at first hand, and they have been told by their most able railroad experts, men whose word they have learned to take at its face value, that it will require some billions of dollars to make the needed repairs and bring our great railroad system, with its 256,572 miles of track, up to standard efficiency And what is true of our railroad system is true in even greater degree of those of Europe, where the damage by war, the lack of skilled workmen, and, above all, the want of adequate funds, for operation and upkeep, have worked with even more disastrous effect. In one country, Russia, which, by the way, possessed before the war the largest total mileage of any European country, the blighting hand of Bolshevism has fallen with tragic consequences. All the reliable evidence that has come out of Russia seems to prove that her railroad system is practically wrecked.

Another burden that lies with crushing effect upon the railroad systems, including that of the United States, is the abnormal increase which has taken place in the pay of the employees. Advantage was taken by the unions of the urgency created by the war to push the pay of railroad employees up to a level far beyond the point at which labor can secure comfortable living conditions, and also far beyond the point at which the railroads can be profitably operated or kept in good condition.

RAILWAYS OF THE WORLD COMPARED

	United States	*Great Britain*	*France*	*Germany*
Mileage	256,572	23,724	25,378	38,866
Locomotives	68,592	24,102	14,344	35,025
Passenger cars	56,290	54,858	31,821	86,873
Freight cars	2,456,607	781,518	370,806	692,053
Investment (T)	$20,967,921	$6,531,751	$3,695,484	$5,045,641
Employes	2,072,971	763,350	459,306	820,461
Passengers carried (T)	1,258,896	1,566,834	541,342	1,797,188
Frt. carried—tons (T)	2,306,190	317,877	208,018	624,067

	Italy (a)	*Russia*	*India*	*Canada*
Mileage	8,953	48,420	36,735	39,196
Locomotives	5,220	19,984	9,068	5,756
Passenger cars	10,024	20,048	24,704	6,376
Freight cars	103,117	450,273	196,747	200,243
Investment (T)	$1,384,928	$3,506,075	$1,854,340	$2,615,102
Employes	154,856	771,938	711,690	184,934
Passengers carried (T)	82,402	195,017	533,180	51,306
Frt. carried—tons (T)	41,099	258,339	87,630	127,388

(T) Thousands.
(a) State roads only

Difficult to Obtain Reliable Railroad Statistics

It will be understood that the ravages of the war and the uncertainties of the post-war conditions render it a difficult task to obtain accurate statistics of the railroads for the past year, but painstaking work has been done both by the Bureau of Railway Economics and by the Bureau of Railway News and Statistics. We publish herewith a table for which we are indebted to the last-named Bureau, which embodies the latest official information received in this country Naturally, nothing up-to-date has been obtainable from France or Germany since 1914, and the figures for Russia date back to 1910. Both France and Germany have been actively restoring their railroads, and the reconstruction of destroyed lines in the devastated regions of northern France must by this time be very nearly complete. With regard to Russia, the reader must be content to take the 1910 statistics and draw his own conclusions as to present conditions. The figures for Great Britain are reliable; those for India up-to-date, and the Canadian statistics are thoroughly reliable.

The United States

The total mileage of the United States, 256,752, is greater by some 55,000 miles than the combined mileage of the seven other countries that are given in the [illegible] table. The total mileage of thirty of

low as compared with over a billion and a half carried on 23,724 miles in Great Britain, and 1,797,188,000 carried on 38,866 miles in Germany This discrepancy is explained by the greater density of the population in those countries, the much shorter distance travelled per passenger per trip, and the very heavy workmen's traffic on steam railroads in European countries. Moreover, the average distance travelled per trip is longer in America than in any of the countries of Europe.

Freight Traffic

Perhaps the most impressive figure, next to our total mileage, is the total number of tons of freight carried per year, which reaches the stupendous figure of 2,305,190,000 tons. The next largest total is for Germany, whose roads carried 624,067,000 tons, and for Great Britain, whose total was 317,877,000 tons. The lowest figure, which is 41,099,000 tons for Italy, shows how that country is wanting in ore, coal and other bulk shipments which serve to swell the totals in great industrial countries like our own, Great Britain and Germany.

Huge Capital Investment

After all, it must be admitted that the most impressive totals are those showing the amount of invested capital for the various roads, which in the case of the

ties was looked for in the United States which would also include the prices of automobiles and which was strengthened by daily cables of falling prices received from the United States. Moreover, it was felt that dollar exchange, which had begun to rise rapidly in September, would fall again when the summer crops began to move Statistics, however, were not available to show the unfavorable trade balance with the United States which existed during the first half of 1920, and the true cause of the rise in exchange was not generally known The summer, normally the selling season for automobiles, therefore passed with comparatively few sales, and the automobiles en route or on contract were left in the custom house at Buenos Aires on arrival By the end of the summer there were 3,500 cars in the Buenos Aires custom house. An increase was avoided, however, by many of the manufacturers agreeing to cancel contracts or stop shipments. On April 5 the stocks were reduced to about 2,800 cars, in addition to about 2,500 knocked-down cheap cars.

Although during the summer of 1919-20, due to the prosperity in the live-stock and agricultural industries, sales of automobiles were heavy, nevertheless during the summer season just passed there has been practically no selling in this line. One agent reported that he was disposing of from 20 to 50 cars monthly, as compared with 100 per month previously, while another had sold only two cars in April and none in the two months previous. The agent of an expensive American car claimed that by placing his price at the maximum the trade would stand (25,000 pesos) there was little profit, due mainly to the high rate of exchange.

Every year there is a marked improvement in the roads of the Republic, and the Argentine cities, almost without exception, have very good pavements. Under normal commercial conditions, therefore, there should continue to be a growing demand for automobiles of all classes, especially with the cheapening of gasoline by the development of the oil resources of the Republic The present stagnation cannot be much improved, however, until there is a normal rate of exchange and until there is a great movement of Argentine pastoral and agricultural products. In the meantime the agents of American firms feel that it is a mistake to stop advertising, although they do feel that the expense should be borne partly by the manufacturers. There is, moreover, every reason to believe that the demand for automobiles will continue to grow after the present depression is over, and that Argentina will easily require each year, for some years to come, upward of 10,000 automobiles of the better class. The largest part of the business can be kept in American hands if the manufacturers will cooperate with the dealers and continue a strong representation in the field.

Science in Safe-Breaking

How Modern Technology Works For and Against the Yeggman

By Roy A. Giles

WAR between nations ends. Disarmament is discussed if not accomplished. The contest between the makers of armor plate and projectiles lags at times, and swords are laid aside, pro tem, even if they are not hammered into ploughshares.

With the planners of safes and vaults, and the safe, vault and bank robbers, however, things are different. Theirs is a war that knows no armistice. One seeks constructively to erect an immovable object. The other plans with merciless science and ingenuity to propel an irresistible, destructive force, which is an old comparison, but an apt one.

Allies on the constructive side of this perpetual argument are the police forces, which include some wonderfully efficient private agency men. The police might be likened to the heavy artillery or "suicide club," in the battle. They wage a relentless war night and day and the list is long of those who have given their lives to the cause.

Some writers delight to picture crooks as lovable, adventurous characters who, by their wit, make laughing stocks of policemen. These writers make crime attractive, and by suggestion keep creating new crooks. The crook in real life, regardless of his particular line of criminal endeavor, is anything but pleasing. A crook is a lower animal who lives a parasitic life. He attacks you, like a mosquito, at night. He steals your chickens like a skunk. He takes advantage of your womenfolks like a savage, and he hides in dark places and prowls around at night like a rat.

Running down the scale of crooks, we find at the bottom, the cracksmen, who are known in the parlance of the underworld as the "yeggs." They gave the name to themselves. The word *yegg* or yeggman originated among the Gypsies and was used to describe a particularly clever crook in the band.

Of all crooks the yeggs are the most brutal, merciless, murderous and cruel. They have been known to commit murder without provocation. They have resorted to torture to locate treasure and have battled a whole countryside in a "get away," shooting men, women and children indiscriminately.

Yeggs are nomadic and migratory. They move in packs or "mobs" of from five to ten members under a leader or "highmobsman." Like all crooks, they drop their real name for a "moniker" or nickname. They take these names from a physical peculiarity, usually, and attach the name of the town, in which they went "on the gun" or became a thief. A fat yegg from Omaha would become "Omaha Fatty," a thin man from Cincinnati became "Cincy Slim," a red haired man from Denver is known as "Denver Pink, the bundle bum," because when he first started out he used to carry one clean shirt, as he liked a change now and then. He later became less fastidious about his toilet. "Goat Hinch" was the leader of a notorious band of yeggs and "Tea" was his right hand bower. "Tea" was called Tea because he steeped tea at the "smudge" or camp fire while the others brewed "java" or coffee. The yeggs have a language all their own. Punk is bread. Soup is nitroglycerine. Jail is jug, prison is stir, a gun is a rod, a freight train a rattler, a safe is a gopher. To snuff a gopher means to blow a safe. To jump bail is to lam, and so on.

To thwart these thieves, who are as crafty as they are cruel, the vault builders have evolved secret processes for toughening and hardening steel, they have invented time-lock mechanisms, burglar alarms, trap guns and have erected vaults, the doors of which, alone, weigh several tons. These larger safes, used in the big city banks are invulnerable to yeggs, but, undaunted, the yeggs go merrily on snuffing the little gophers and ripping and smashing, destroying and stealing.

Inspector John Coughlin, chief of detectives of the New York headquarters staff, says of the yegg:

"The yegg burglar is distinct among criminals regarding mode of operation and method of living. The most sought recruits among these fellows are machinists or mechanics who lose their employment and drift, finally meeting some professional yegg who recognizes the value of the recruit in his knowledge of handling tools and explosives.

"These men drift away from relatives and have no responsibilities. They make money easily and spend it lavishly. In some instances they make as much on one 'job' as they could earn all their lives at a trade. Their homes are cheap rooming houses and their hang-outs cheap saloons usually conducted by former yeggs.

"The yegg has his attention drawn to the small town without adequate police protection. His intent is to rob a postoffice or bank. He hopes in case of arrest to escape from the small town jail which is insecure in most instances. They resist arrest, however, and try to shoot their way out of town if discovered in action. It is general practice to have a receiver of stolen goods dispose of loot on a percentage basis. This person attends to furnishing bonds and employing 'mouthpieces' or lawyers, in case of arrest.

"One of the band visits a town carrying postcards and poses as a vendor. He makes observations as a 'finder,' locating the place to be robbed and mapping the lay of the land and the 'get away.' He reports to the chief yegg. They usually 'hit' the town by breaking into a garage and stealing an automobile. They arrive in town well after midnight. Two remain outside as 'stalls' or lookouts, the rest enter as 'blowers.' The inside men blow the safe with nitroglycerine obtained by boiling down dynamite stolen from contractors along railroads or near coal mines."

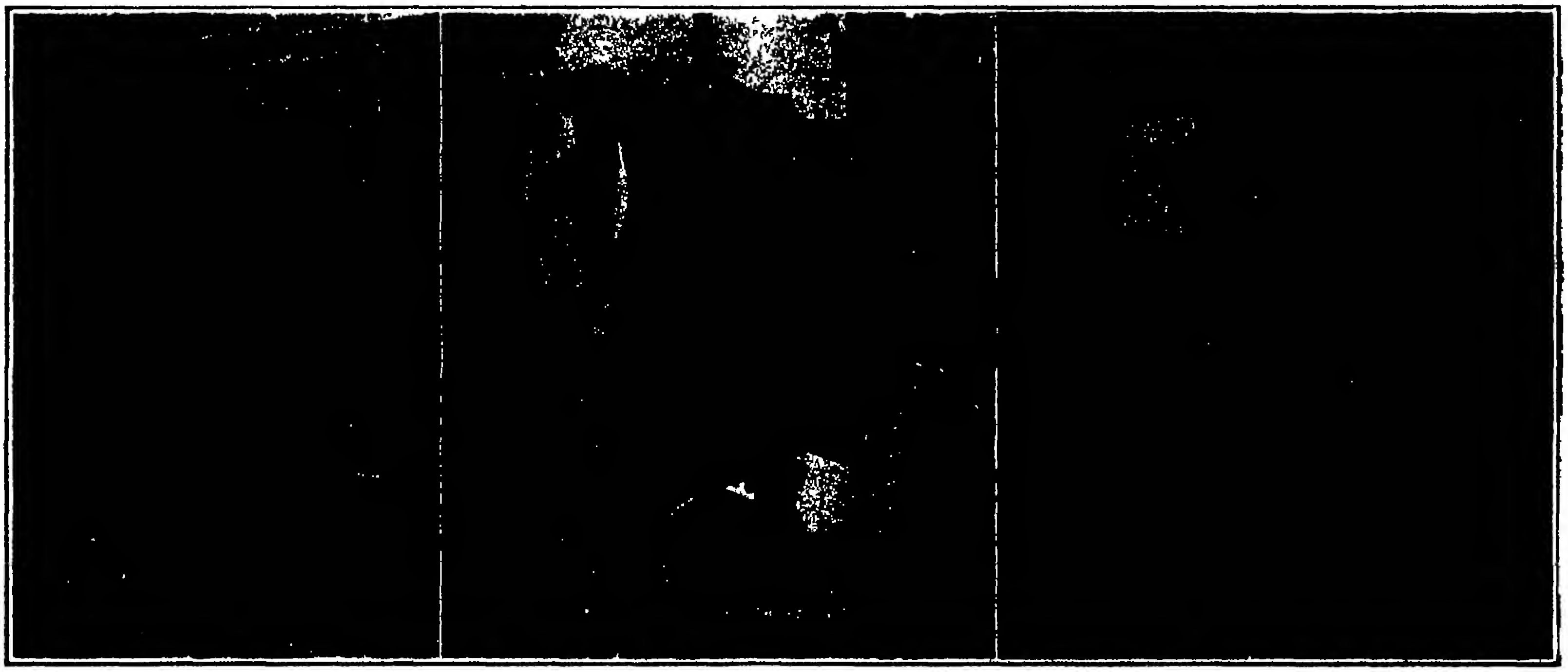
It would seem that bank and postoffice safe-blowing would be a game that would hardly attract women, yet in these days of equal rights and vices there are women yeggs. To cite two cases:

In the Merchants Bank at Kansas City, Mo., there is deposited $500 reward for the arrest of Mattie Howard, who jumped her bail, or "lammed." Mattie is also known as Mrs. Frank Vanders. She is 28 years old and pretty. She is physically perfect and seemingly mentally acute. She dresses well and makes a good appearance. She has been a yegg, police records show, since she was a young girl. She has worked as a telephone operator, as a blind to her real profession. Her first arrest was when she was 23 years old. A Kansas City police department circular, asking for Mattie dead or alive, reads in part as follows:

"She will be found with bank robbers, postoffice robbers and smugglers. Often goes out on the job dressed as a man and may be now disguised as such. She is a leader and planner of the most dangerous type. May now have her hair auburn or any other color. Natural color is dark blonde. Born, Preston, Idaho. May work as telephone operator. Care should be taken in making arrest, as she would not hesitate to commit murder at any time."

Margaret Brooks, wife of Harry Brooks, is suspected of yegg activities. She and her husband are both held in Pittsburgh on a charge of murder, in connection with the killing and robbing of a messenger for Boggs & Buehl, a department store. This job netted the perpetrators $48,000.

Police departments and the manufacturers of safes and vaults object to detailed descriptions of mechanisms and manufacturers' processes being printed in mediums of general circulation. It can be said, however, that in the time of the early yeggs, before the automobile days, when railroad handcars were often the means of getaways, an ordinary drill would bore a hole in a safe. There are safes now which will turn a drill bit. When the acetylene torch was brought into general use the yegg promptly adopted it as accompanying illustra-



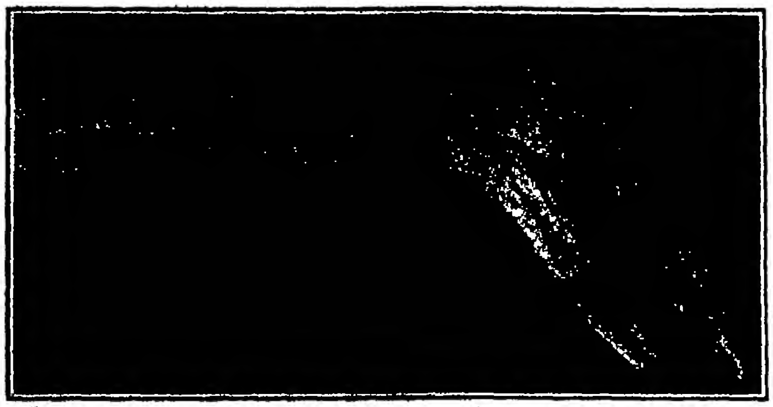
Left: This safe offered unusual resistance to the acetylene torch but was robbed just the same by burning a hole around the combination knob. *Center:* A safe of the common "gopher" type blown with nitroglycerine; a post-office job. *Right:* A "combination" job, calling for the use of nitroglycerine to blow off the outer door and of the acetylene torch to open the inner chamber

Some results when modern technology is impressed in aid of the safe-blower

tions will show. What has been accomplished by the builders in resisting this torch is shown in the following case.

September 27, 1921, loft of S. Kaplan & Company, New York. The outer door of the safe blown open with nitroglycerine. Torch was used on inner door, made of a new process "fireproof" steel. This door successfully resisted all efforts of the cracksmen, the torch failing to affect it materially. The yeggs failed to get $200,000 in money and securities which the safe contained. Three safes in the lofts of E. J. Bass, silversmiths, 618 Broadway, New York City, recently resisted acetylene torches in similar fashion.

The best products of the safe builder's art are the massive vaults in the big banking institutions. These are of steel and concrete construction, with ponderous doors hung on a balance which permits their opening and closing by no more effort than can be exerted by a small child. They are protected by intricate time-lock devices and burglar alarms. The yegg is yet to live who can even make an impression on these vaults. They have never even tried to any extent, most of these vaults remain unmolested. The yegg realizes that he cannot hope even to get near these safes, and could he get near them his efforts would be futile. In these safes his force has met an immovable object.



The "can-opener." This tool rips strong steel plates just as the familiar kitchen implement opens the sardine box. The attack is made at the rear of the strong-box

Often in the cases of ordinary commercial safes, even the larger kind, the strong boxes have been known to yield to a sledge hammer in the hands of what might be termed a "fancy sledge swinger" The combination knobs have been knocked off with the hammer and the tumblers of the lock worked through the small hole, where the knob had been.

The thinner sheets of steel used on the backs of some safes have yielded to a device known as the "can opener" pictured in the accompanying illustration This is fashioned from a crowbar or wagon axle, and given a specially tempered and processed point and cutting edge This device is never used by a yegg, but a class of cracksmen has sprung up who make use of it. It has ripped sheet steel, just as a can opener rips the top of a sardine box.

A joke in the safe business is a small safe in Wichita, Kansas, won by its owner as a prize for tobacco coupons. This safe, because of a defect in construction which allows the force of an explosion to blow out, as a charge would blow out of the muzzle of a gun, has resisted four nitroglycerine explosions in the last 19 years It has been hammered and banged and bungled about, but no yegg has ever opened it. It would not resist acetylene gas, however If anyone ever turns a torch on that safe, it will probably melt and run out under the crack of the door The material of which it is constructed is so malleable as to be almost plastic

Writers of lurid fiction and drama love to tell of the "Alias-Jimmy-Valentine" type of cracksman, who works on strong boxes with no tools but his lily-white hands. He is supposed to be able to work the combinations of safes by sense of touch and hearing. In the pictures he is seen sand-papering his fingers to make the nerve ends acutely exposed. Few of these men exist. Ten weeks ago a certain authority believed that none of them existed. But they do exist, and here is the proof

June 22, 1921, three combinations on three different safes in the offices of the Sinclair Oil Company, tenth floor of a big office building were worked either by sense of touch or hearing. No finger prints or other clews were found. The job netted the perpetrator, and it is believed there was but one man on this job, $200,000, in stocks, bonds and money. To reach the safes this man had to pick the lock at the street door, elude watchmen and scrub women, make his way to the tenth floor and pick the locks on doors into and between offices, four doors in all. Besides opening the safes, this prowler picked the locks on several desks for good measure.

The combinations of these safes were not all known to any one man Three clerks knew one combination each The combinations were not in any of the desks robbed Every indication points to one fact, and that is that the cracksman either felt or listened his way into those three safes during some period of time between Saturday night and Monday morning. He worked either with gloved fingers, or had painted his finger lines out with collodion In the annals of crime this successful triple safe job stands out as the cleverest ever recorded.

The effects of a nitroglycerine explosion on a triple-plate steel safe

A peculiar misunderstanding resulted in the accounts of this masterful safe robbery effort finding its way into the newspapers. It had been intended that the case should not be given publicity, because, having been unusually successful, its being published would tend to suggest further crimes along the same line, or at least further attempts, for few men live who could duplicate it

But—a reporter was browsing around the Old Slip police station He heard two detectives talking and went back and wrote the story. Through a mistake, the source of the information was given as the Pinkerton National Detective Agency, which has never been known to give out newspaper information in the many years it has been in operation. The last thing in the world this agency would have discussed with a reporter was this particular robbery However, the reporter had it, and through a general spilling of the beans the agency got tangled in the publicity

Our friend the Inspector has said that yeggs often make as much on one safe robbery as they could earn in a lifetime at their trade BUT—when they are out of jail—which is seldom, for most yeggs spend most of their lives in penitentiaries at hard labor—they endure hardships that few men would care to wish upon themselves. Drinking alcohol out of a tin cup, or taking drugs to steady their nerves, they live between jobs and arrests, hunted, haunted and hounded. Carrying nitroglycerine in a rubber bottle around their neck, or more carelessly handling dynamite and the deadly "soup," they are always in danger of meeting a swift and rather a scattered death, even if they escape being perforated by a police sniper or watchman The record of "Michigan Shorty"—a sour-faced, open-shirted artist—should deter all who might have ambitions to go a yegging The record follows, abstracted from the New York police file:

Number of picture in gallery, B-41639. Name, Thomas Murray Alias, Michigan Shorty, John Mack, etc

Criminal record (as far as known)—1898, Allegheny Co., New York, receiving stolen goods, Elmira Reformatory

1909, Broome Co, New York, 59 days, County Jail.

1909, March 26, Fillmore, N Y, post office burglary, 5 years, Atlanta Penitentiary

1915, burglary, post office, Snake Hill, N J penitentiary, one year

1915, February, Wilkes-Barre, Pa., suspect, no disposition.

1915, April 15, Philadelphia, Pa., suspect, discharged.

1916, April 6, as Thomas Murray, New York City, burglary, discharged, Magistrate Breen, Police Court

1920, June 1, as John Murray, New York City, safe burglary (fugitive), delivered to the Federal authorities, June 10, 1920, no final disposition of case

All in all, the yeggman's lot is not a very happy one, and the thrills and excitement are of a very low order indeed. The risks taken by the yeggman are so great, and the chances of making a real "haul" so slim, as to make the game a poor one at best.

A complete outfit for the "yegg" job of opening a safe without the use of the acetylene torch. The set comprises one brace, one drill, one wrench, one wood-chisel, one putty-knife, one screw-driver, one punch, three drill-bits, one oil-can, electric wire, rope, and two bottles of "soup" (nitroglycerine)

Wire Rope Fractures

THE mathematical principles involved in the examination of the strength of steel ropes and the fracture of wire ropes open up questions regarding which no general agreement has yet been obtained. Dr E. M Horsburgh has made a new contribution to this subject, and touched on some controversial questions.

The experimental work was carried out at the research laboratory of Messrs. Brunton, Musselburgh The usual method of determining the forces is by resolving them both vertically and horizontally by the usual statical method This method, it is asserted, is based on an incorrect hypothesis. The effect of combined stress was considered experimentally and theoretically in the paper With regard to the modulus of elasticity of the rope, the author pointed out that this has been confused with Young's modulus. The stress strain curve of a rope, in contrast with that of a structural member, can be represented by a single function of one variable, and the gradient of this function is the rope modulus. An analytical expression was given, and the fitting of this to the data was discussed Finally the author dealt with the wires of steel haulage ropes in actual use

This work should prove a valuable contribution at a time when we are testing all manner of things to preclude accidents.

"Alabama" attacked by a 2000-pound demolition bomb. Shows the ship as seen from the air. Note the splash of fragments over wide area

The "Alabama" as she appeared after being shattered and sunk by army fliers. The blowing in of the hull below water is matched by this frightful wreckage of decks, masts and smoke-stacks above water

The 4000-Pound Demolition Bomb

A Means for Detonating 2000 Pounds of T.N.T. on a Selected Target

By Major William A. Borden, U. S. A.
Chief, Aircraft Armament Division,
Office of the Chief of Ordnance

A FOUR-THOUSAND-POUND demolition bomb, the largest bomb so far produced in the world, was recently tested by the Army Ordnance Department, at Aberdeen Proving Ground. This bomb represents the latest development in a systematic program which is being followed by the Ordnance Department in the preparation of armament for aircraft, and is believed to be the most powerful and efficient weapon of its type produced by any country

When bombs were first used with aircraft they were comparatively small, but with experience in testing and use many types have been developed until they now differ widely in construction and vary in weight from a few ounces to several thousand pounds. During the war the largest bomb manufactured in this country weighed 1100 pounds, and some produced abroad weighed as much as 2000 pounds. Shortly after the signing of the Armistice a careful study was made of bombs by a board of officers appointed by the War Department, and as a result a program was prepared which covered the development of all types of bombs, some to be even larger than those used during the war

For several years the Ordnance Department has been engaged in perfecting the designs of the smaller bombs and until the present year no work was undertaken on bombs larger in size than those weighing 1100 pounds. During this time all bombs obtained from British, French and German sources during the war were studied and tested.

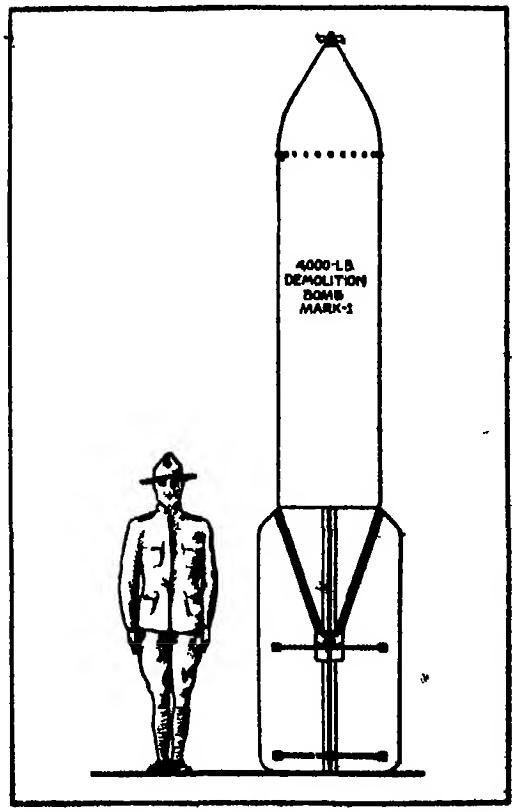
When it became known that extensive bombing tests were to be held with the ex-German ships, turned over to this country, it was appreciated that these tests would afford a great opportunity to obtain information as to the value of large demolition bombs. As a result the development of a 2000-pound bomb was immediately started, and in a few months the production of several of this type, for use in the bombing maneuvers, was completed These were used against the ex-German ships and the ex-U S S. "Alabama" with highly satisfactory results from a bomb-design standpoint, but since it was realized that bombs even larger might be required to destroy the largest naval targets or demolish land targets, such as great munition factories, sea-coast gun emplacements, railroad terminals and storage depots, it was decided to extend the development program already outlined to include the design of a 4000-pound bomb.

Of all bombs, those of the demolition type have the widest field of application and are therefore of great military importance. They carry a large amount of high explosive, the charge being from 50 to 60 per cent of the total weight of the bomb, and when they strike, a terrific blast is produced by the detonation of the charge, which, within its destructive range, causes tremendous damage

Demolition bombs are used in attacking manufacturing plants of all types, storehouses, ammunition dumps, railroads, railroad terminals, docks, locks, naval vessels of all types and similar material targets. In bombing any of these objectives that size of bomb is used which will insure, if possible, not partial but complete destruction of the target.

To the average person, bombs are merely large cannonballs filled with some sort of explosive, but to those engaged in their design they are very complicated mechanisms which must fulfil certain very definite requirements.

In designing a demolition bomb the main object is to produce a bomb body which will hold the greatest possible amount of high explosive and yet be strong enough to withstand impact with a target, or even to penetrate it. When a factory is attacked the maximum amount of damage is produced if the bomb penetrates the roof and floors of the building and functions only after it has reached the ground floor or basement, for then the force of the detonation fairly bursts the building apart. Of course, a bomb of this type will not penetrate heavy armor, but must be so designed that it will pass through the roof and floors of the ordinary factory or warehouse.



A six-foot soldier and a 4000-pound demolition bomb, drawn to same scale

These bombs must be equipped with two fuses, one in the nose and the other in the tail, so that if one fails the other will function. Under certain conditions the fuses must be furnished with delay elements so that on impact the bomb will have time to penetrate before it functions, as, for instance, in the case of an attack against a manufacturing plant. Where only surface destruction is desired the fuses should be set for instantaneous action upon impact. For example, when a city is attacked and the bomb strikes in a street, it should function instantaneously, so that the force of the detonation will not be absorbed in the formation of a crater but will be directed as a blast against the walls of the adjacent buildings. Also, for surface effect, fragments of the bomb case are particularly effective, but if the action of the fuse permit a delay, the bomb will bury itself, and when it functions a large number of fragments will be caught in the crater and be ineffective.

In attacking naval targets the most effective results are obtained when the bomb strikes close alongside a ship and the fuse delays the detonation until the bomb reaches an appreciable depth It then acts as a mine and blows in the side of the ship.

When the target is a line of communication, such as

[illegible]

a road or railroad, a large crater effect is desired on account of the resulting difficulty of restoring the roadbed, and to produce this a slight delay is required, enabling the bomb to bury itself before detonating

The fuses must be so designed that the bomb can be carried by airplane with perfect safety, for in the event of a crash the safety devices in the fuses must prevent the bomb from functioning Also in case of a forced landing when it is necessary for the safety of the airplane to release its load of bombs, the mechanism of the fuse must allow them to be dropped "safe"

In designing the bomb body careful consideration must be given to adaptability to stowage of the bomb in the airplane, to its proper flight and to efficient blast effect The structure of the present airplanes requires that large bombs be carried outside the fuselage, but since in that position they offer added resistance to the passage of the airplane through the air, a "stream line" form should be used if possible This "stream-line" form is also of advantage since it tends to give high striking velocity and reduces the time of flight All bombs must fly true and to insure this they are guided in their flight by four fins, properly proportioned with respect to the body and attached to it The direction of blast from the detonation of a charge in a bomb is approximately perpendicular to the exterior surface of the explosive, and the bomb case should be so designed that the maximum blast will be in a horizontal direction as this is most effective against the usual target.

Finally, the bomb as a whole must be designed so that it can be produced in quantity in this country utilizing such facilities as will be available for its manufacture in the event of war This last consideration is of the utmost importance

With these general requirements the design of a 4000-pound bomb was undertaken. The results obtained with the 2000-pound bomb had been so satisfactory that this bomb was used as a guide

The pictures show the bomb as developed It is 13½ feet in length and 2 feet in diameter The body is a cylinder of steel tubing each end of which is closed by a steel casing the nose being brought to a point the rear end being a slightly convex plate ribbed to carry a rim over which the cone of the fin assembly is fitted The fin assembly is made up of four large sheet steel fins riveted to a sheet steel cone The fins are braced in two places by steel tubes extending between the fins and riveted to them The fin assembly is held to the body of the bomb by a steel tube which extends backward from the rear of the body, a nut on the tube engaging against the rear end of the cone and forcing the cone over the rim of the casting at the rear end of the bomb

The bomb is equipped with two fuses one in the nose the other in the rear end of the bomb body These fuses can be equipped with delay elements as desired so that instantaneous action or delays of a few hundredths of a second up to several seconds can be obtained The fuses have the usual wind wheel safety feature which operates as the bomb falls the wind wheels releasing the firing pins so that on impact the primers in the fuses will be struck and the bomb detonated

For attachment to the airplane two lugs are provided which are bolted to the bomb body at equal distances from the center of gravity and spaced to fit the carrying device

The bomb though designated as the 4000-pound demolition bomb actually weighs about 4300 pounds and has a main charge of about 2000 pounds of T N T The design was drawn up by the Aircraft Armament Division in the office of the Chief of Ordnance, at Washington the production of the metal parts was handled by Frankford Arsenal Philadelphia Pennsylvania and the loading was done at Picatinny Arsenal Dover New Jersey

The body was probably the largest container ever loaded with high explosive and one week was required for the filling of each bomb The explosive T N T is melted and poured into the case in increments time being allowed for each increment to solidify before the next is added It is interesting to note that after final pouring the charge was four days and more in cooling, while only about six hours are necessary for the charge of a 10-inch shell to cool

The testing of the bomb took place as has been mentioned at Aberdeen Proving Ground The largest airplane available at this time was a Handley Page and the question naturally arose first as to whether it could lift so great a load and second as to what effect the release of so much weight all at one time would have upon it A bomb loaded to weight with inert material was therefore used first to test the airplane and the carrying device The airplane took off successfully and the bomb was dropped without apparent difficulty The officer of the Air Service who piloted the airplane stated that when the bomb was released the airplane shot up about twenty feet but the effect was no greater than that from a bad bump often encountered in flying

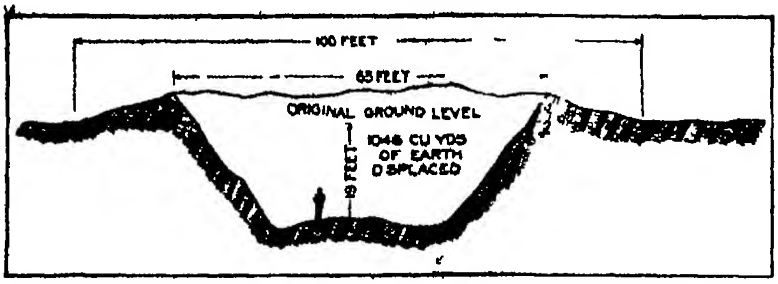
With this problem disposed of everything was ready for the final test A loaded bomb was taken up and released from an altitude of 4000 feet The observing party was stationed for safety in a tower fully 2000 yards from the point of impact but even at this distance every feature of the test was clearly discernible

The bomb fell perfectly without apparent oscillation and to those watching appeared like a large pencil dropping from the sky When it struck a great mass of earth and dense black smoke was blown up hundreds of feet in the air and several seconds later the crash of the detonation reached the observers. The bomb was equipped with a short delay fuse which allowed it to penetrate at least ten feet before it detonated The formation of the crater smothered to a certain extent the blast or concussion from the detonation so that it was scarcely felt at the observation point The pilot and observer of the airplane, however though 4000 feet above reported that they felt a decided bump

The crater formed was immediately inspected and its appearance is clearly shown in the pictures and sketch As the crater was approached it appeared like a small fort The earth from the crater had been thrown out forming a rampart five feet high around the edge 1046 cubic yards of earth had been displaced and a hole 10 feet below the original surface of the ground and 65 feet in diameter had been blasted out This was probably the largest crater ever produced by a single projectile Inside and around the crater jagged fragments of the bomb case were found, varying in weight from a few ounces to several pounds which against a material target would have added greatly to the destructive effect of the blast

Further tests of the 4000-pound bomb will be made to ascertain more completely its destructive effect but considering the results already obtained and the targets against which it will be used in time of war it is doubtful if a bomb of greater weight will be constructed for some time

Witnesses of the destruction of the Ostfriesland and Alabama were deeply impressed by the work of the bombs both in wrecking the superstructure and in sinking the ships by crushing in the hull below water The targets it is true were anchored but over against this is the fact that aerial bombing is a comparatively new art capable of great development

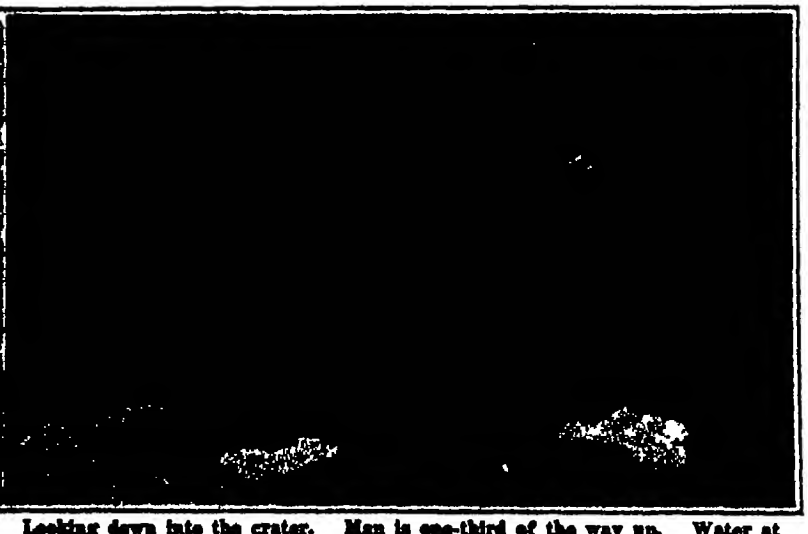


This is an exact cross-section of the crater caused by the 4000 pound bomb at Aberdeen Proving Ground The soil, falling back after the explosion, partly fills the crater and forms an embankment or rampart around its periphery

In practice the fin and fuses are not assembled to the bomb until the body is attached to the airplane The shot truck is used in maneuvering the bomb under the airplane A 25 50 and 100-pound bomb are shown for comparison in size

The bomb completely assembled resting on a shot truck

[illegible] shows how the earth is thrown up at the instant of the detonation of a large [illegible] bomb, which has occurred well below the surface



Looking down into the crater. Man is one-third of the way up. Water at bottom is from a source opened up by the shock of detonation

Leading Armies of the World

Comparison of the Active Armies, Trained Reserves, Available Manpower and Field Artillery of the Five Leading Powers

IT is a rather formidable task to attempt to make a reliable comparison of the strength of the various military powers—this for the reason that the late war, and the reduction of forces since the war, have made so great a difference in the strength and composition of armies, as compared with pre-war times, that only to the officers of our Military Intelligence are the facts known with any close degree of approximation. The table which is herewith published is made up from their statistics and represents the very latest figures that are obtainable as we go to press. The totals are mated by the War Department, is 3,085,990. This figure includes about 188,990 reserves, consisting of the National Guard and the Officers' Reserve Corps. At present there is no enlisted force in the Reserve Corps. In addition to these, there are 2,847,000 (estimated) non-enlisted veterans of the World War. The total available manpower of military age in the United States is estimated by Army Intelligence as 15,700,000

Great Britain

It will be noticed that Great Britain is credited with the grand total shown in our table. The enormous total available manpower of military age of 25,000,000 given for Great Britain is to be explained by the large extent of the British colonies, but mostly it is due to the teeming millions of India. These figures are estimated by our Army Intelligence; and to arrive at a total, there was taken 5 per cent of the total population in India, 20 per cent in New Zealand, 12 per cent in the United Kingdom and 15 per cent in Canada, Australia and South Africa. All these percentages impress one as entirely reasonable

The above comparison shows the relative strength of the armies of the leading nations, as estimated by the United States Army authorities

given for the strength of the active army, the strength of the trained reserves, the total available man-power of military age, and the total number of field guns with the active army

The United States

The strength of the active Army of the United States, as recently fixed by law, is 157,537 officers and men. This body is provided with a total of 300 field guns. By field guns must be understood mobile artillery, up to and including that of 6-inch caliber. The heavier artillery, whether caterpillar-mounted or on railroad mounts, or designed to be transported to the front and fired from fixed emplacements, is not included in these 300 guns. This reservation applies to the totals of the guns of all the armies included in this table. It will be seen that the strength of our trained reserves, as estimated by the War Department, is

an active army of 625,000, but it should be understood that this includes 274,000 white troops of the United Kingdom, of which 200,000 are serving at home and 74,000 are serving in India and are paid for by the Indian Government. The rest of the British total, or 351,000 of the active army, are colored troops, the bulk of which, of course, are in India. The total of 6,216,000 trained reserves of Great Britain includes an estimated total of 6,000,000 veterans of the World War and 216,000 men of the Regular Army Reserve, the Special Reserve and the Territorial Army. The total of field guns of the British Army, up to 6-inch caliber, is estimated at 864 guns with the British Army in the United Kingdom only. The number of guns outside of the United Kingdom is not known. To be added to this are 546 guns in the hands of British Artillery units serving in India with the Indian Army, the two items together giving

France

The active French Army has a strength of 864,000; and the strength of the trained reserves included in 28 classes is 4,420,000. The total available man-power of military age is 5,304,000; and the total number of guns with the active army is 5840. It should be understood with regard to this artillery that, due to skeletonized organizations, all of the guns are not manned. The large proportion of the trained reserves of France and Italy to the total man-power of military age is very significant and speaks eloquently of the supreme effort made by these gallant countries in the recent war.

Italy

The strength of the active army of Italy is 300,000; and behind it is a trained reserve of 4,518,000, slightly larger than that of France. The total available man-

power is over five million, and the total number of field guns is 2160. As in the case of France, only a part of these guns are manned, due to skeletonized organizations.

Germany

Germany, as we all know, was required under the Treaty of Versailles to reduce her huge army to an active strength of 100,000, and this has now been done. Under the head of trained reserves, in our table, there is a blank which is to be explained by the fact that no organized reserves are allowed to Germany by the Peace Treaty. On the other hand, it is estimated by our Government that there are in Germany today 4,800,000 trained reserves, out of a total available man-power of six millions. The total field guns in Germany today are 288. This small figure shows how Germany has carried out the provisions of the Treaty, which called either for the surrender or destruction of its artillery. According to figures given out by the Disarmament Commission, Germany has destroyed 82,000 guns.

Japan

The strength of the Japanese active army is 302,000, and the estimated strength of her trained reserves is 1,748,000 out of an estimated available manpower of 6,519,000 In this matter of trained reserves, then, it is evident that Japan does not stand in nearly so favorable a position as France, Italy or Great Britain. The total number of field guns with the active army is 1172.

The Smaller Nations

Although they are not included in our table of the five leading nations, figures for Belgium, Holland and Portugal will be of interest. They are as follows Belgium has an active army of 120,078, a trained reserve of 260,000, an available manpower of 1,125,000 and 772 field guns, all of which are not manned. Holland has 40,000 in her active army, including 20,000 organized militia. She has 860,000 trained reserves, a total available manpower of 1,000,000 and 171 field guns. Portugal's active army is 61,000, her trained reserves 622,000. Her available manpower is 922,000, and there are with the active army 292 field guns.

It will be noted that our table takes no account of guns in reserve—this for the reason that hitherto these figures have not been available. The various powers apparently are reluctant to make them known. The reserves of artillery are necessarily very large; and because the greater part of it is thoroughly up-to-date it is not likely that it will suffer any serious depreciation for many years to come.

THE LEADING ARMIES AT A GLANCE

	Strength of Active Army	Strength of Trained Reserves	Total Available Manpower of Military Age	Total Field Guns with Active Army
United States	157,537	3,085,990 (g) estimated	15,700,000	800
Great Britain	625,000 (a)	6,216,000 (b) estimated	25,000,000 (h)	1210 (c) (d)
France	884,000	4,420,000 (28 classes)	5,304,000	3840 (f)
Italy	300,000	4,513,000	5,063,000	2160 (f)
Germany . .	100,000	See note (e)	6,000,000	288
Japan	302,000	1,748,000 estimated	6,519,000 estimated	1172

(a) This includes the 200,000 white troops serving in the United Kingdom and 74,000 serving in India and paid for by the Indian Government. The remaining 351,000 are in India and on the Rhine, in Mesopotamia, Silesia, Palestine, and elsewhere

(b) Includes 6,000,000 (estimated) non-enlisted veterans of World War, and 216,000 Regular Army Reserve, Special Reserve and Territorial Army

(c) 864 Guns with British Army (United Kingdom only—others not known).

(d) 346 Guns in hands of British Artillery units serving in India with Indian Army.

(e) No organized reserves allowed Germany by Peace Treaty, but there are estimated to be 4,900,000 men who were in her former army

(f) All guns are not manned, due to skeletonized organizations.

(g) Includes 188,990 trained reserves (consisting of the National Guard and Officers' Reserve Corps. No present enlisted force in Reserve Corps), and 2,847,000 (estimated) non-enlisted veterans of World War

(h) Estimated.
Of total population in India, 5% has been taken for this estimate
Of total population in New Zealand, 20% has been taken for this estimate.
Of total population in United Kingdom, 12% has been taken for this estimate.
Of total population in Canada, 15% has been taken for this estimate.
Of total population in Australia, 15% has been taken for this estimate.
Of total population in South Africa, 15% has been taken for this estimate.

High-Speed Fighting Ships

By Hector C. Bywater

FROM the engineering point of view, the most striking feature of naval development in recent years has been the enormous increase in the power of propelling machinery. Figures which a few years ago would have been considered fantastic, if not impossible, are accepted today as commonplace. When completed in 1912 the British battle cruiser "Lion," designed for 70,000 shaft horsepower, was spoken of with bated breath, and more than one engineer of repute publicly expressed doubt as to whether any ship could be built to stand the tremendous strain of such a power plant working at top speed. Three years later the "hush-hush" battle-cruisers "Renown" and "Repulse" were laid down, the contract calling for 110,000 to 120,000 shaft horsepower On her trial runs, made with the ship at normal draught, the "Renown" worked up to 126,000 shaft horsepower and covered the measured mile at a speed of 32.68 knots; her sister ship "Repulse," at deep load, reaching 119,025 shaft horsepower and a maximum of 31.7 knots. Although the scantlings of these two ships were exceptionally light, the hull exhibited no sign of structural weakness even when running "all out" in a seaway. Both ships, it may be mentioned, have Brown-Curtis direct-drive turbines.

The "Hood" marks a further big increase in engine power, for in order to drive this 41,200-ton mastodon through the water at a rate of 31 knots it was necessary to equip her with machinery of 144,000 shaft horsepower. This vessel is the first British capital ship to have geared turbines (Brown-Curtis type) and small-tube boilers. No official details of her steam trials have been published as yet, but it is known that she developed nearly 160,000 shaft horsepower and a speed of 31.9 knots on a displacement of 44,000 tons—that is, 3400 tons more than her normal displacement In less than eight years, therefore, the "record" figure established by the "Lion" has been more than doubled Nor is there anything to indicate that finality has been reached in this particular line of naval progress. The "Hood," in her turn, will be eclipsed by the six battle-cruisers now under construction for the United States Navy. Owing to modifications in their armor and underwater protection, the weight of these vessels has been increased from 35,300 tons to 43,500 tons. To achieve the designed speed of 33¼ knots, the machinery, consisting of turbines with electric transmission, will have to work up to 180,000 shaft horsepower —rather more than five times the figure for the battleship "Arizona," which as late as 1916 was the highest-powered vessel in the United States Navy

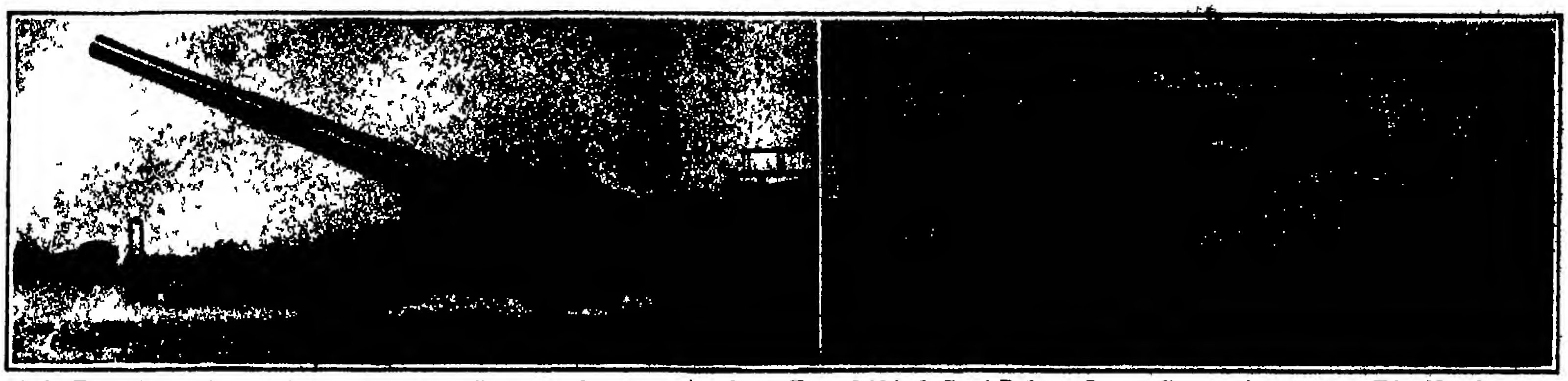
Equally remarkable is the advance which has been registered in the steam power of light cruisers. For the time being the record in this respect is held by the "Hawkins," a vessel of 9750 tons, completed last year and now serving as British flagship in China She is fitted with geared turbines of 60,000 shaft horsepower, which give her a speed of 30 knots. There are four ships of this class, one of which, the "Effingham," is building at Portsmouth and not yet launched. Two further light cruisers of new type are now completing in England, namely, the "Enterprise" and "Emerald" Both were laid down only a few months before the war ended, but as a good deal of work had been done upon them they survived the wholesale cancelling of contracts which followed the signing of the Armistice. A third ship of the same class, the "Euphrates," was, however, scrapped. The "Enterprise" and "Emerald" represent a most interesting type of light cruiser. They were designed to act as scouts and screening cruisers for the British battle-cruiser fleet, a service demanding speed considerably superior to that of ordinary light cruisers. At the same time it was stipulated that they were to be of moderate displacement and to have an armament powerful enough to deal with the latest German light cruisers, which had a broadside of five 5.9-inch guns. The "Enterprise" displaces about 6500 tons at normal load. Her length over all is 565 feet, her extreme breadth 54½ feet and her moulded depth 30 feet 7 inches. It was ascertained by experiments with tank models that the desired speed could not be reached if anti-torpedo bulges were fitted and consequently this form of protection was dispensed with But to minimize as far as possible the damage from torpedo or mine explosion, the boilers are divided into two widely separated groups, one group being placed forward and the other group well aft. The hull is also placed very extensively subdivided Owing to the peculiar spacing of her three funnels, the 'Enterprise' bears a strong resemblance to the battle-cruiser Lion" She is engined with Brown-Curtis geared turbines developing the enormous figure of 80,000 shaft horsepower through four shafts, and a speed of 34 knots is confidently anticipated Her main battery comprises seven 6-inch 50-caliber range-finding guns—of which five are on the center line and one on either beam This gives a broadside of six guns and an end-on fire of four guns In addition, there will be the usual anti aircraft and machine guns, and twelve torpedo-tubes on triple-deck mountings. A deep belt of 3-inch high tensile steel covers the sides in way of all machinery and boiler spaces, and is reinforced by a 1 inch upper deck The absence of an anti-torpedo bulge, to which the British Navy has learned to attach great value, is considered a serious defect in these two ships. War experience did not bear out the assumption that high speed is itself a protection from submarine attack. Two British light cruisers, "Nottingham" and "Falmouth," were torpedoed whilst steaming at 24 to 25 knots, and zig zagging, and there were other cases of ships being hit by torpedoes when traveling at full speed

Just as the "Hood" will shortly be out classed by the U S.S. "Lexington" and her sisters, so in the near future will the "Enterprise" have to yield her place as the fastest light cruiser afloat to the new American vessels now building These ships, 10 in number, will displace 7100 tons and have geared turbines of 90,000 shaft horsepower for a speed of 35 knots. It will be noticed from the tables given below that in general dimensions and armament they are somewhat similar to the "Enterprise," but their lines are not quite as fine.

According to authentic report, Japan has a very large programme of light cruisers in hand. The number of these vessels, as given in a list prepared by the U S. Office of Naval Intelligence, is no less than 34 The "Tatsuta" and "Tenriu," begun in 1916, are in general design and appearance very much like big destroyers or flotilla leaders. They are 3500 ton ships, designed for 28 to 30 knots, and are armed with four 5.5-inch 82-pounder range-finding guns and six deck torpedo-tubes. In 1907 five cruisers of a heavier type were laid down as the "Kuma," "Tama," "Oh-I," "Kitakami" and "Kiso," names commemorating Japanese rivers. These vessels displace 5500 tons and have geared turbines of 65,000 shaft horsepower, from which a speed of 34 knots is expected They are said to have an abnormally large oil-fuel capacity and a cruising radius of about 12,000 nautical miles. They carry a battery of seven 5.5-inch range firing guns, mounted in positions which enable five to train on the beam and four ahead and astern.

THE WORLD'S FASTEST LIGHT CRUISERS

	U S.S. No. 4-13	H M S. Hawkins	H.M.S. Enterprise	Japanese Kuma
Year of completion	1921-22	1919	1920	1920
Length over all, feet	555½	605	565	500
Beam, feet	55	65 (over bulge)	54½	49½
Draught, feet	13½	17½	16	15½
Displacement, tons	7100	9750	6500	5500
Shaft horsepower	90,000	60,000	80,000	65,000
Designed speed, knots	35	30	34	34
Fuel capacity, tons	.	2000 (coal & oil)	1500 (oil)	2100 (oil)
Armament . .	12 6-in R.F, 4 T Tubes	7 7.5-in. R.F, 6 T Tubes	7 6-in. R.F, 12 T Tubes	7 5.5-in R.F, 4 T Tubes
Protection . .	Thin belt, no bulge	3-in belt, bulge	3-in. belt, no bulge	3-in belt, no bulge



Left: Test of 16-inch 50-caliber Coast Defense Gun on barbette mount. *Right:* Test of 16-inch Coast Defense Gun on disappearing mount. This rifle, the most powerful in existence, is about 70 feet long, and weighs 152 tons. It fires a 2340-pound shell with a charge of 850 pounds of powder. The muzzle velocity is 2700 feet per second, the muzzle energy, 121,000 foot-tons, and the range, at 45 degrees of elevation, is 50,000 yards, or about 30 land miles. This gun can penetrate the armor on any foreign ship at any range

The New Army Sixteen-Inch Gun

Exhibition Firing of the Most Powerful Coast Defense Gun in Existence

WHAT was probably the most elaborate program for the demonstration of new war material was that drawn up for the Third Annual Convention of the Army Ordnance Association, which took place recently at the new Proving Ground at Aberdeen, Maryland. The Army Ordnance Association is to be congratulated upon the extent and variety of the exhibits and the admirable precision with which the program was carried out in the presence of the several hundred assembled guests, including not only the members of the Ordnance Association, but also of the American Society of Mechanical Engineers and the Society of Automotive Engineers.

Limitations of space in the present article prevent the publication of any adequate details of this remarkable display of ordnance material and of the various demonstrations in the way of proof firing, bomb dropping and maneuvering of caterpillar-mounted artillery This will be understood when it is stated that there were over fifty separate exhibits of new material, part of it developed in our preparation for the late war and much of it representing absolutely new work which has been carried out by Army Ordnance since the Armistice.

Proof-Firing of Sixteen-Inch Army Gun

The first exhibit was the most spectacular and, indeed, the most important of all. It was the proof-firing of two 16-inch Army guns, weapons which from time to time have already been discussed in our columns. The first of these was the firing with full charge of a shell from the 16-inch coast-defense disappearing gun shown in our illustrations. The second was the firing of a similar piece in the new barbette mount. Both of these guns have been designed for our coast fortifications at home and abroad, of which they will form the most important and most powerful elements.

The Projectile

The 16-inch projectile, as will be seen from our illustration showing one of these alongside an officer whose height is six feet, is spectacularly big both as to height and bulk Its exact weight is 2340 pounds. It is provided with a false nose made of light steel, which is screwed on at the forward end of the projectile, and is stream lined so as to afford the easiest possible entrance for the shell as it passes through the atmosphere Within the false nose is the blunter actual nose of the shell, which is provided with a cap of soft steel to assist the shell in shattering the extremely hard face of modern armor, so as to open the way for the body of the shell itself Just how effective the projectile is as an armor piercer may be judged from our photograph of a 14-inch armor-plate which has been pierced, at extreme range, by three of these projectiles.

The Rifle

It can be readily understood that to impart a velocity of over half a mile a second to a shell weighing over a ton calls for a rifle of very exceptional dimensions and power The 16-inch rifle which was built at the Watervliet Arsenal from designs drawn up by the officers of our Army Ordnance, is so well proportioned that the guests at the recent exhibition, although they were all technical men and familiar with large mechanical constructions, found it difficult to realize that this gun barrel was within a foot of being 70 feet in length, that its bore was 16 inches, and that it weighed 340,000 pounds or 170 American short tons. Another surprise came when the 850 pounds of powder which constitute a charge were fired. Both the burst of flame from the muzzle and such brown smoke as there is when "smokeless" powder is fired, were up to expectations, but the report was surprisingly "soft" for a charge of these great dimensions. However, this was not surprising to those of us who are familiar with proving ground effects. The writer remembers that when he was on board the "North Dakota" during battle practise, the sharp crack of a 5-inch gun was more severe on the ear drums than the deeper-noted report when the 12-inch gun was fired.

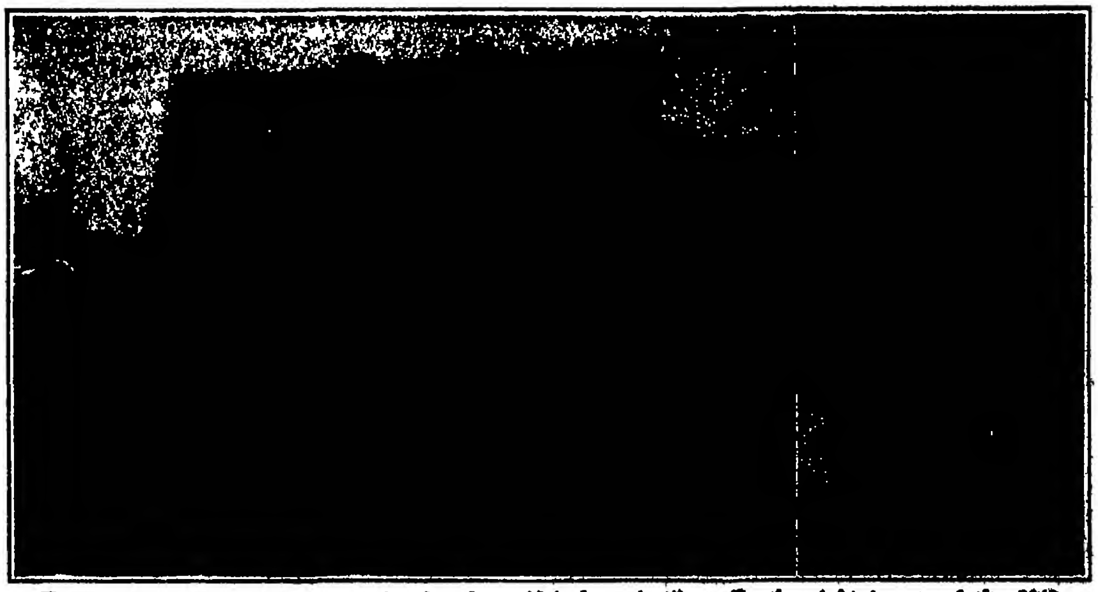
The barbette mount functioned satisfactorily, and the heavy rifle swung back and down into the loading position with the same smoothness and absence of jar which has marked the smaller mounts for guns of 8-, 10- and 12-inch caliber The roof-like structure is an inclined shield of sufficient thickness to protect the gun attachment from small shell fragments and machine-gun fire.

The Sixteen-Inch Barbette Gun

Not far from the 16-inch disappearing gun was a sister rifle on a barbette mount. In the disappearing mount, the gun, upon discharge, is thrust back and down until she is below the parapet and sheltered from direct fire. In a barbette mount the rifle is permanently above the face of the parapet. The gun and its carriage rotate upon a massive turntable, consisting of a base ring bolted to the concrete foundation, and an upper ring known as the "racer," between which are 42 live rollers. A pinion attached to the racer engages a circular rack bolted to the outside of the base ring. By this means and by means of a micrometer index which is carried on the racer, the gun and its carriage can be laid in direction with an accuracy of $^1/_{60}$ of a degree. An electric motor and hydraulic speed gear permit the carriage to be traversed by power

Bolted to the movable platform, one on each side, are two cast steel side frames in which rest the trunnions, the elevation of the gun being controlled by circular racks bolted to the right and left sides of the cradle. The range of elevation is from minus 7 to plus 65 degrees. The cradle forms a circular sleeve in which the gun recoils, and this cradle contains or supports all the mechanism which controls the recoil and counter-recoil of the gun. The cradle is a 50-ton casting, the inside of which is very accurately bored to fit the outside contour of the gun. The actual bearing on which the gun slides consists of a number of circular bronze strips bolted to the inside of the cradle. The gun and cradle, which together weigh 550,000 pounds, are so accurately balanced on the trunnions that one man, by hand power, can easily set the gun at any angle of elevation. Elevation, normally, is effected by electric motors.

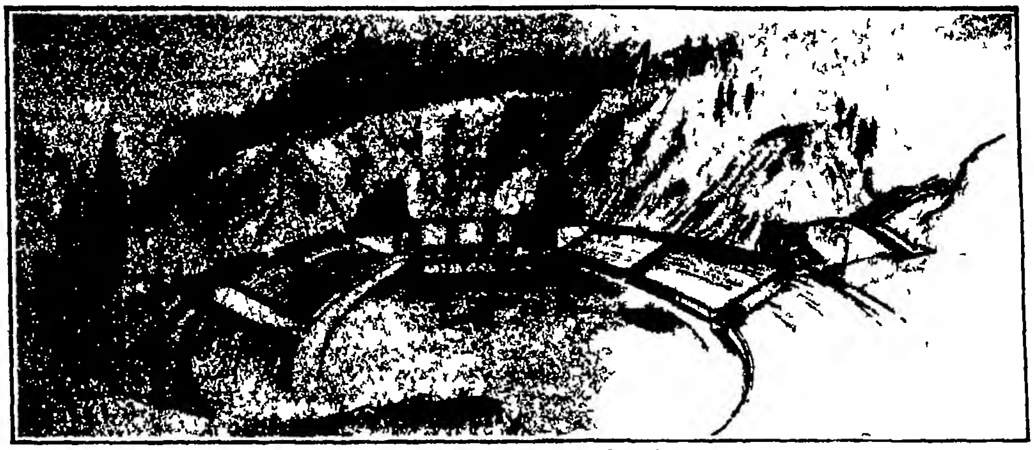
The recoil is controlled by four oil cylinders, cast integrally with and around the cradle. The energy of the recoil is dissipated by throttling the oil with which the recoil cylinders are filled, by causing it to pass from the rear to the front of the piston through grooves cut in the wall of the cylinders. There is also a counter-recoil mechanism which serves to return the gun gently into battery —that is, into firing position. When the gun is laid at an elevation of 45 degrees, it has a range of 50,000 yards, or nearly thirty land miles. Even at this great range the shell will pass through the heaviest armor afloat in any foreign navy, as witness the 14-inch plate shown at bottom of this page.



Heavy armor plate after penetration by three 16-inch projectiles. To the right is one of the 2340-pound shells

Seats for 125,000

Oakland's Giant Stadium, Cut Out of the Center of a Mountain



Architects's drawing of the "Stone Bowl," Oakland's record stadium, as it will look when completed

CARVED out of the heart of a mountain of solid stone, a huge stadium is to be constructed at Oakland, Cal., according to H. H. Dunn in the *Boston Transcript* The hill has been purchased, the inside hollowed out, and now all that remains to be done is the installation of the concrete tiers of seats, the gates and the Greek stage. When completed, this stadium will have a seating capacity of 125,000, and a total capacity, including the arena, or floor of the stadium, which covers three and one-half acres, of approximately 850,000 — a greater number than the population of the city which is constructing it The hill itself covers five acres, and is somewhat more than 125 feet in height

Owned some years ago by a company engaged in quarrying, this hill today is nothing but a shell of stone, a million and a half cubic yards of rock having been taken from its heart, leaving a perfectly flat, smooth floor of stone, walls in the shape of a complete circle surrounding this arena, and sloping slightly outward, as cut by quarrymen to prevent caving Thus the walls are all ready for the construction of the tiers of seats and the concrete or stone stairways down into them. At one side of this artificially hollowed, yet natural, bowl or crater of stone, the quarrymen cut an entrance, narrow and straight, through which they carried away the rock blasted out of the mountain. This, which is the only opening into the inverted cone, will be converted, by means of concrete pillars, platform and gates, into a Greek entrance way

Directly opposite the entrance to this huge quarry pit is a perpendicular cliff some 135 feet in height by about 200 in width at the base, against which the concrete stage, very simple and of early Greek type of architecture, will be constructed The arena in front of the stage is large enough to play a full game of outdoor baseball, a football game, or hold a track meet of the largest size, while it will offer an unexcelled place for public meetings of all kinds, being large enough to accommodate all the residents of Oakland, men, women and children, at one time. A concrete wall will be placed around this arena, and from this wall seats will rise in tiers, as in the ancient Coliseum, with six concrete stairways between them, leading from the arena to the very top of the surrounding wall of natural rock. The plan is to erect these seats only half-way up the wall at first, thus providing seating accommodations for 125,000, but to add other tiers of seats as they may be needed The solid stone walls give the bowl remarkable acoustic properties.

The old quarry, as it is hidden by a growth of gum and other trees, and as it has a very narrow approach or entrance, is ideal for the purposes of a stadium. It is protected by its high walls and trees from the glare of the sun, and the amount of work necessary to prepare the site of the seating, the stage and the arena is not difficult, nor will it necessitate any large expenditure of money.

The gully entering from the north side has been utilized as a stairway leading to the top of the cliff and carrying people to their seats easily and conveniently The stairways sweeping each side of the entrance give a wonderful and beautiful approach to the seating portion of the stadium, and also have the advantage of distributing the audiences without confusion The surrounding cliffs are subject to horticultural treatment, which will greatly enhance their beauty and their effectiveness as a background

The "Stone Bowl," as the stadium site has come to be called, is only ten minutes by street cars from the heart of Oakland, and about five minutes from the residence district around Lake Merritt It is directly at the end of one of the longest and most popular paved driveways of the eastern shore of San Francisco Bay From the cliffs above the site of the stage one looks out over Oakland and San Francisco Bay clear into the Golden Gate An effort is being made to complete the stadium in time to hold in it the next interscholastic games on this side of San Fransisco Bay The cost will be comparatively light, since the quarrying company already has expended some $1,500,000 in the removal of the stone heart of the mountain, but left the hard rock floor level and the walls intact.

The cliff at the base of which the Greek stage is to be constructed in the natural stadium at Oakland. The spring and pool in the foreground are to be converted into a mirror lake at the foot of the stage

New Way to Recover Tin from Scrap Tin Plate

THE recovering of metallic tin from tin plate scrap such as tin cans, etc., is an important industry and quite extensively employed in the United States. A method has been patented in England for recovering such tin which is of considerable interest Briefly it is as follows

Tin scrap is treated with oleum to dissolve the tin, and the material is then lifted out of the acid and washed in water Fresh acid is added to replace that used, and another batch is treated After a time a basic sulfate $SnSO_4$ SnO, deposits, and is drawn off The washing water contains some insoluble oxide, SnO_2 and some tin in solution The dissolved tin is recovered by precipitation as sulfide or iron is added to neutralize the acid and obtain metallic tin External heat is not required in the process, but the acid bath is maintained by the exothermic heat and the periodical additions of fresh acid at a fairly constant temperature of 45—55 degrees Centigrade and a strength of about 10 per cent free sulfur trioxide

Stainless Iron—A New and Striking Product

STAINLESS steel is already a familiar product and much has been said about it It is on the tables and in the kitchens of many American and British homes. But a new material has very recently appeared in England which is also the home of stainless steel. The new product has been named stainless iron and it is receiving much attention over there but is very little known in the United States

The new stainless iron is really a milder grade of stainless steel which is a moderately high carbon, and therefore hard, steel containing about 12 to 14 per cent of chromium which bestows the stainless qualities. The main difference between stainless steel and stainless iron lies in the percentage of carbon, stainless iron having no more than 0 10 per cent carbon or about one-third that usually incorporated in stainless steel The new iron is described as distinctly softer than stainless steel and amenable to manipulation operations quite impossible in the case of stainless steel These working properties adapt it to use in hundreds of different directions, and it is believed that the requirements for stainless iron in the future are likely to be enormous, and to come from the most unexpected quarters.

It is anticipated by British authorities that the discovery of the alloy will profoundly modify industry so far as light metals are concerned Because it is softer and more malleable, it can be forged, pressed and drop-stamped and hence utilized for a multitude of articles, parts and fittings which are now made of ordinary iron and various other metals, liable to be easily oxidized It is stated that experiments in making the bonnets and wheel discs of automobiles of the new stainless iron have already proven successful, and pioneers and promoters of rustless iron are confident that its possibilities are almost unlimited

Our Point of View

Soaring Men

THAT man would ever be able to soar as the birds do seemed as idle a suggestion when it was first made as the prediction of Professor Langley that man would some day fly through the air with a power driven machine The Wright brothers after proving that power driven flight was possible made some experiments to prove that it was possible also to soar in a motorless plane Such results as they achieved proved that successful soaring on any extended scale would require the construction of a very special machine The Germans forbidden by treaty to build power driven airplanes have turned to the development of soaring machines and to judge from the results achieved in the Soaring and Gliding Competition recently held in the Rhön District they have made a surprising and very creditable advance

It seems that no less than 45 machines were entered in the competition None of these carried any engine or means of mechanical propulsion and all were constructed of extreme lightness and along lines which the builders considered to be best suited for soaring The achievements both in the competition and in subsequent flights were truly astonishing One man was in the air 15 minutes and 40 seconds during which time he covered a total distance of over four miles Not the least remarkable feature of this flight was that his gliding ratio was 1 in 32—that is to say for every foot of vertical descent in still air he advanced at least 32 feet Even more remarkable for duration was the flight of another glider who was in the air for 22 minutes before he lost control and crashed The finest achievement however was that of a Klemperer Aachen glider a monoplane which remained in the air for 13 minutes and covered a distance of over six miles

The details of this achievement which took place after the competition had closed are given by a writer in *Flight* who records that several machines reached heights considerably above their starting points. In the 13-minute flight of the Klemperer Aachen monoplane it is stated that the pilot reached at one time a height at least 300 feet above his starting point According to a map of his course he described figures-of-eight and sharp turns and indeed flew his machine with the apparent control of a power driven airplane During the first part of the flight with the wind against him he made little headway but attained considerable height Then on turning across the wind he gained speed over the ground and the last half of the flight which was generally with the wind was covered in three minutes or at a speed of about a mile a minute, which is pretty good for a machine without a motor

Critics of the various performances, among whom was Handley Page speak of the designs of the gliders as being generally well thought-out The wing loading was very light averaging about 1¼ pounds per square foot The take-off is of course an important feature, and the machines leave the ground quickly We are told that in taking advantage of the gusts of wind the pilot elevated as much as he thought the machine would stand, and when the gust was dying down he flattened out to the gliding angle

Soaring for such lengths of time as these is possible only where upward currents of air are present Skill in soaring consists in finding these currents and so manipulating the plane as to remain within them as long as possible On the other hand the pilot must extricate himself from a falling current or even from stationary air as quickly as possible for in these he will rapidly lose altitude and come to earth

The Gentle Art of Translation

ONE of the least appreciated of the arts, we have always felt is that of good translation It has always seemed to us that any thought capable of expression in one language was equally capable of expression in any other civilized tongue of adequate vocabulary Words to be sure, exist in French for which no single English word is able to do duty But we do not believe that any connected expression of meaning can exist in French and defy transference into any of the major modern languages The only praiseworthy translation is one that can successfully pose as original composition Just as the table that shows marks of plane and saw is crude and unfinished, so is the literary composition unfinished that exhibits indications of the process whereby it was turned from German into English.

The rarity of translations that meet this standard is sufficient to give force to our initial remark. Nor is it difficult to put one's finger on the root of the trouble It will be granted that the English speaking person with halting command of French cannot translate into good idiomatic French Parts of his production will be faultless to be sure but other parts will show the evidences of English origin cropping out like a sore thumb It might on the other hand seem that a dictionary knowledge of French coupled with good command of English would be a satisfactory combination for translation from French into English That it is not so will appear on closer thought

The person who is in any way deficient in the language of the original text has continually to look up words of the original He has to search carefully through a column and a half of alternative renditions of words like the German *Zug*' the English case In the doubtful hope that he will hit upon the correct one Many times he has to hang up the first half of a sentence while he endeavors to settle the significance of the latter part only to find that this cannot be done until he is sure what the first clause is all about. The man who has to read say his German original word by word and patch it together word by word again to form the translated English text is working against a handicap which cannot possibly result otherwise than in a bastard production of English words in German grammatical forms and German mannerisms of expression, with just as much certainty as though the linguistic deficiency were on the other side And if in the bargain the translator be a person of no slightest literary capacity, with absolutely no style of his own, no sense of what is strong and what is weak in his native tongue, there is missing the last check which might operate to hold him to a respectable performance

Lest we be accused of exaggeration we quote with faithful attention to every detail the following gem, culled from a manuscript received in ordinary course from a professional translator "To bring the weighing to a vacuum and preserve in the reductions the precision of the forty thousandth it is necessary therefore to possess the elements of calculation of the thrust with a superior precision, which may be roughly fixed at a hundred thousandth ' It will be noted that this, unlike the uproariously funny translation from German by a German which we copied from one of our Einstein essays some months ago, does not present anything which is definitely meaningless or wrong, its amusing character and the success with which it betrays its French origin lie merely in the use of expressions, technically correct and meaning what they are designed to mean, but which no English-speaking person would ever dream of using After we had tinkered with it a bit, it read. "When we attempt to weigh objects in a vacuum, if we are to attain a margin of error as low as .0025 per cent, it is necessary that we be able to calculate the thrust even more closely—say, within a margin of .0001 per cent." Why could not the translator achieve this result?

The trouble with this passage—which exemplifies the sort of thing that happens everyday in commercial translation—is simply that the translator was not sufficiently acquainted with French to read the original, getting its meaning as he would have got that of an English sentence A large proportion of the translation that is done today is done under this handicap, and results of the sort quoted are inevitable. It cannot be too strongly emphasized that translation is an art, if anything, more difficult than original writing. The man who writes the original has something to say, and he says it. The translator has nothing to say he must listen to what another has said, and resay it in the secondary tongue. When he has no alternative but to repeat it substantially word for word, of course he runs afoul of a thousand and one divergences between the usage of the two tongues involved. Some of these things the incompetent translator will get right, because he has learned to take every advantage of a dictionary that reveals them when it can But never will the man who is not a thorough master of both languages involved produce a translation that cannot be identified as such.

Looking Forward by Looking Backward

IT seems but a short while back that we were describing in these columns the interesting but hardly promising experiments of numerous inventors with the wireless telephone Such descriptions were accompanied by photographs showing a veritable mass of instruments and wires and still more instruments, arranged in that unsystematic manner so typical of the laboratory installation And to be quite truthful, from the early wireless telephone experiments of the Danish experimenter and inventor Poulsen, to the pre-war long-distance attempts both here and abroad, very little of a commercial value had been realized.

It is such a well known story that reiteration would only prove detrimental—this story of the remarkable development of the wireless or radio telephone since the days of our participation in the World War In the short space of two or three years the radio telephone became a practical everyday means of communication, available for all manner of purposes, and exceeding by far the wildest dreams of the early workers in this art.

And what have we today? Radio telephone stations being installed as rapidly as possible in every leading center of the United States, for the purpose of sending out news bulletins, baseball scores, stock reports crop surveys, weather bulletins, sermons, public speeches, and even music These broadcasting stations, as they are called, are being installed and operated by large manufacturing companies, who are anxious to furnish such service in the positive knowledge that it will increase the demand for radio apparatus The Government, too, is about to install radio telephone broadcasting stations, which are to replace in whole or at least in part those stations now rendering a similar service in the dot and dash language of the Morse telegraph code.

Nightly, this American ether of ours is filled with all manner of conversations reports, bulletins, sermons, and music. Already in many an American family the evening's diversions depend a great deal on the activities of the broadcasting stations. With a loud-speaking telephone on the living-room table and with a simple receiving set the members of the family can receive all the news that is worthy of widespread attention, followed by a musical program

But what of the future? Truly, there is no end to this radio telephone thing The transmission of radio telephone conversation is still a somewhat expensive and elaborate task, especially if any real distance is to be spanned, although for short distances the equipment is quite simple and inexpensive But in the broadcasting feature, we have only begun Perhaps it may be that a time may come when special broadcasting stations will be operated for the sole benefit of certain subscribers, who will pay a monthly or yearly fee for the service. How the broadcasting stations will prevent non-subscribers from securing the full benefit of the service is a problem, to be sure, but we anticipate that a quite satisfactory and simple manner will be found to protect such service against unlicensed receiving sets. Perhaps the means may be an arrangement of com-

Our Point of View

steadily shifting wave lengths for the transmitter, with the same shifting wave lengths at the receiving end, the commutators or other devices performing this function being carefully synchronized. At any rate, if such a service should be found profitable and set up quite distinctly from the present gratuitous services, we may look to the day when the American family, by a slight adjustment of its radio receiving set, designed like a cabinet phonograph, may turn from heavy Wagnerian opera to light American musical comedy, and from a French song to a Slav march. Not plain phonograph music as at present, mind you, but real music from the leading theaters and concert halls of the nation. A worthwhile by-product for the theater and concert hall—and for the church, when we come to think it over.

A retrospective survey is just as astounding as this look ahead. So why may we not reasonably expect these various things to come to pass?

Last Voyage of the "America"

THE racing schooner "America," after seventy years of adventure such as seldom, if ever, has befallen a yacht, recently ended her wanderings and found a permanent and honored resting place at Annapolis. We might make diligent search of the records of yachting and not find another craft so famous, or one that has exerted so immediate and lasting an influence upon yacht architecture, as regards both model and sailplan.

It was in 1851 that Colonel Stevens and his confreres commissioned George Steers to design them a racing schooner, modeled upon the general lines of the famous pilot boats of that day. She was to be sent across the ocean for the purpose of racing against the best of the English cutters and schooners. The challenge possessed double interest from the fact that the proposed contests would be between representatives of the two leading maritime nations and between two entirely different types of yacht. The English cutter of those days, and the schooners too for that matter, were modeled after the so-called "codfish head and mackerel tail" plan, with rather blunt, full bows and a long, easy run aft. The "America," on the contrary, had a long, fine entrance and a greater ratio of beam to length. Moreover, the point of greatest beam was well forward of amidships in the cutters, but well aft of it on the "America." The most marked difference, however, lay in her rig, and particularly in her sails, which were so cut as to lie fairly flat to the wind, an effect which was greatly helped by the American practise of lacing the foot of the sail to the boom. The hempen sails of the British yachts, on the contrary, were relatively baggy, as compared with "America's" suit, and the foot of the sail was not laced to the boom, but allowed to hang in a rather full curve below and to leeward of that spar.

There can be no question that the fine weatherly qualities of the "America" exercised an influence upon yacht design throughout the world. The blunt bow disappeared, sails were re-cut and laced to the boom, and British yachts began to show the characteristic features of the American schooner.

In later years a somewhat similar influence was exerted in the period of sloop-versus-cutter races that set in about 1885 and continued for the next eighteen years. The development of yacht design in America and Great Britain, during the thirty-four years between the "America's" day and the famous races between the sloop "Puritan" and the cutter "Genesta," had been along widely different lines. We had developed a type of yacht with great beam, a shallow body, a deep centerboard, inside ballast, moderate displacement, and a large sailplan. Great Britain, thanks to a faulty rule, had developed a model with extremely narrow beam, a deep keel carrying a heavy load of lead, great displacement, and a small sailplan.

In the series of races that followed, the sloop invariably won against the cutter, until the first "Valkyrie," a Watson boat, with more beam and larger sailplan, showed qualities that made her a dangerous competitor against the centerboard sloop "Vigilant." Thereafter each type began to adopt the best features of the other, as will be seen from the fact that the "Defender" of 1895 had 19 to 20 feet of draft, as against 8 to 10 feet in the "Puritan" and other earlier sloops, was minus the historical centerboard, had over 80 tons of outside lead ballast, and carried a highly developed cutter rig. Her competitor, "Valkyrie," on the other hand, showed the shoal body and great beam of the sloop (her beam was about 26 feet as against the 15 feet of the early cutters) and had her mainsail laced to the boom. So closely have the later yachts approximated that in the races last year, it was difficult, at a distance, to tell the American from the English yacht. To find broad differences between them, it was necessary to see both boats together in drydock and climb aboard. Here the difference was very marked.

Sixteen-Inch Guns Then and Now

SOME fifteen years ago we were one of a party of guests who had been invited to Sandy Hook to witness the firing of the first 16-inch gun to be constructed in the United States. This was a built up gun, designed by the Bureau of Ordnance of the Army, which was to serve as the type gun of a considerable number which were to form the principal weapon of our coast defenses. It was of the old, short-caliber, low-velocity type, which has since become obsolete for direct fire. Its length was only 35 calibers, and its muzzle velocity was about 2100 feet per second.

When the guests reached the grounds, they were received by Captain Crozier (better known to the present generation as General Crozier, Chief of Ordnance in the early part of the late war), and taken over to the Proving Grounds to inspect the new "monster gun." Captain Crozier stood upon the loading platform and briefly explained the characteristics of the gun. He concluded by telling us that this was the first time in the history of artillery that such a large charge as 600 pounds of powder had been fired. "I have full confidence in the powder," he said, "and am aware of no reason why it should not function as satisfactorily when it is fired in such a large mass, as it does in the much smaller charge used in our 12-inch guns, but in order to prevent the possibility of any injury to the guests or the personnel, I will ask you all to retire behind the distant bomb proofs." Which we all did.

Nothing untoward happened. The powder burned progressively, there was none of that pernicious "wave action of the gases," which was believed to have caused the bursting of one or two experimental guns a few years before, when smokeless powder was somewhat of a novelty to our ordnance experts.

That 16-inch gun, which was welcomed into the family of Brobdingnagian ordnance with so much acclaim, was destined to lead a solitary and neglected life for many years to come. Just about that time the fashion in ordnance began to run to long guns of 12-inch caliber, or thereabouts, in which armor-piercing energy was sought rather in the direction of velocity than of mass in the projectile. The Army built no more 16-inch guns, preferring to develop a 14-inch gun of long caliber and high velocity. The big fellow seemed to be regarded as somewhat of a white elephant, and it required the stimulus of the war to cause it, at last, to be shipped to Panama and installed as part of the defenses there.

Fifteen years after witnessing the firing of this first 16-inch gun, we received an invitation to attend at Aberdeen the firing of our second Army 16-inch gun, a 50-caliber piece, firing a 2940-pound shell with the high velocity of 2700 feet per second. As at Sandy Hook, the guests were given some of the particulars regarding the gun, among which was the announcement that the powder charge would weigh 850 pounds. It was just here that our mind was carried back to Sandy Hook, and the similar little talk given us by Captain Crozier, and by no means the least vivid item in this recollection was the fact that he warned us all to get behind the bomb proofs because of the enormous charge of 600 pounds of powder which was about to be fired. But in spite of the fact that some 500 or 600 guests, including many of the most famous engineers in America, to say nothing of quite a galaxy of high ranking military officers, were grouped closely around the gun, no suggestion whatever was made by the Proving Ground spokesman that we should even retire to a reasonable distance, much less to the bomb proofs.

Now the moral of all this, thought we, is not that Captain Crozier showed an unnecessary solicitude for the health of his guests, but that the advance in the manufacture of gun steel and of smokeless powder has been such, in the intervening years, that the bursting of a heavy piece of ordnance like this at its proof firing is about as likely a possibility as that a baby carriage will collapse when it is loaded with its first smiling infant. We have progressed far beyond the stage when hidden flaws can exist in the metal of a gun, or wave action during combustion may rip the gun apart.

Gas Turbine Perplexities

THE advantages to be derived from the development of a successful turbine are many and obvious, so much so that many of our ablest physicists and engineers have devoted earnest thought and effort to the problem of producing a prime mover of this type. Unfortunately, results have been in the direction of proving what cannot be done rather than what can, and it must be confessed that there are certain outstanding problems, both theoretical and mechanical, which, for the present at least, appear to be insuperable.

The literature upon this subject has become quite extensive, chiefly in the form of papers read before technical societies. We find one of the latest and most illuminating discussions of the subject in a recent issue of *The Engineer*, which frankly confesses that here is a problem that certainly embraces more genuine difficulties of a mechanical nature than were ever provided by the steam turbine or the internal combustion engine, while the thermo-dynamic considerations involved are in a class entirely by themselves.

The first outstanding difficulty is to overcome the losses in producing the required compression. Rotary compressors are ruled out because the pressures obtainable are too low, 100 pounds per square inch being the best that hitherto has been obtained, also it is a cumbersome method. Hence the reciprocating compressor is essential. But here we come up against the problem of dissipating the heat absorbed by the cylinder and cylinder head. The dilemma presents itself of keeping down the temperature of the metal, without reducing the temperature of the gas so far as to involve a big loss in thermal efficiency. A boiler furnace, it is true, stands 2500 deg. Fahrenheit, but the furnace metal transmits the heat, whereas the turbine metal must retain all it can hold short of being ruptured. This part of the problem is still unsolved.

The next outstanding question is that of effecting a compromise between the high velocity of the high-pressure, high temperature gas, and the maximum allowable velocity of the turbine blading. Here it is found that, with stiff shafting, a peripheral speed of the blades of about 500 feet per second is the limit. But this is too slow for gas efficiency. Nor does compounding help very greatly. As matters stand today, the gas turbine, in thermal efficiency, falls far short of the best reciprocating gas engine, indeed we are told that the largest gas turbine unit, so far built, realized only 25 per cent of its designed output of 1000 kilowatts.

Hope for the future lies in the possibilities of water injection into the combustion chamber. By this expedient it would be possible both to reduce the temperature to the desired point and to utilize, on the blades of the turbine, the potential energy thus transferred from the gas to the water. Theoretically, the injection method is attractive.

Abraham Lincoln and the Repeating Rifle

How an Inventor's Struggle for Recognition Was Assisted by the Action of the President

UNDOUBTEDLY one of the secrets of President Lincoln's success in dealing with difficult problems was his fine sense of proportion He saw the essentials and took hold upon them with a firm grip. So clear was his vision and so logical his mind that in studying a complicated problem he saw the controlling facts of that problem standing up as sharply and distinctly as the great peaks of the Alps stand out from the foothills below them Consequently, he obtained results with a minimum of effort and moved to his goal with the directness of a well-shot arrow to the bullseye.

As always happens in such an emergency, Washington, during the War of the Rebellion, was flooded with inventions, and the various departments, the Congress, and even the White House itself, were invaded by a crowd of earnest men, who believed they had devices by the use of which victory for the Union forces could quickly be assured. Among those who went thus to Washington was a certain Christopher N Spencer, a young machinist from New England He carried with him a repeating rifle of his own design and bearing his name, which was destined to have a large share in the ultimate success of the Union armies, and was to become famous throughout the world

The Inventor of the Repeating Rifle

The publishing of the present article about an invention which was fully described in our columns sixty years ago is due to the fact that Mr Spencer is still alive—very much alive—and that he recently came in person to our editorial offices for a little talk about those early days. He brought with him as his visiting card a photostat of the front page of the SCIENTIFIC AMERICAN of January 25, 1862, containing drawings and description of his repeating rifle, the first of its kind to be successfully operated Also, he left with us an extremely interesting photograph of a target made by Mr Lincoln with one of the new rifles which he had given to the President.

Mr Spencer carries his eighty-eight years very lightly and finds his recreation in active work His memory is clear, even to details, and he sketched out the salient features of his life, when these were requested, with a facility which showed how gently the years had touched him.

Sharps' single-shot breech-loader was brought out in 1848, and in 1857 young Spencer, then twenty-four years of age, conceived the idea of building a repeating rifle with the magazine running down through the inside of the stock He worked over the problem, making experimental guns until, in 1859, he felt justified in applying for a patent. It was granted to him on March 6, 1860 In those days he was working for Cheney Bros., silk manufacturers, of South Manchester, Conn., the place of his birth, and while with them he obtained a patent for an automatic silk-winding machine. This, by the way, has historic interest also, from the fact that it was the machine "with which Pratt and Whitney began manufacturing in their first rented room in Hartford" From his boyhood up firearms had exercised a strong fascination over Spencer and his spare time was given over entirely to the development of his gun.

Secretary Gideon Welles Helps Him

It seems that Charles Cheney, his employer was a close friend of the Hon. Gideon Welles, Secretary of the Navy, and he and Spencer took a rifle to the Washington Navy Yard, where it was required to stand a test of firing 1000 rounds without cleaning. In the course of this trial Spencer was officially timed to have fired twenty-one shots in sixty-two seconds. This brought an order from the Navy Department for one thousand guns.

The navy contract had been filled many months before any order could be secured from the War Department. There was something strongly suggestive of times more modern when Mr. Spencer told us that a certain general of that day, "the fossil of the Ordnance Department, would not approve any 'new-fangled jimcracks.'" Recourse was had to the assistance of James G Blaine, the Speaker of the House of Representatives, and through his influence and that of President Lincoln a contract was signed by the Assistant Secretary of War, Thomas Scott, for 10,000 of the new weapons. Before the close of the war the Government purchased 200,000, which did great execution at the Battle of Gettysburg and in other important battles of the war.

On left, Mr. Spencer, now 88 years old, with his original repeating rifle of 1860. On right, Mr. Guy Hubbard is holding a Sharps single-shot breech-loader of 1848

Photograph of target made by President Lincoln in 1863, in a friendly contest with the inventor. The second shot, just below the white point, is a bullseye; the others are bunched closely around it

Mr Spencer's account of his meeting the President, as related to us by himself is full of interest and is characteristic of the great directness and simplicity of Mr. Lincoln's character.

"Among my most pleasing recollections of the war times was a shooting match which I engaged in with President Lincoln. I had been delegated by our company to present the President with one of the rifles, which I did on August 17, 1863. On my arrival at the White House I was ushered immediately into the reception room, with my repeating rifle in my hand, and there I found the President alone. I took the rifle from its cloth case and handed it to him. He examined it carefully and handled it like one familiar with firearms. He requested me to take it apart and show the 'inwardness of the thing.' After carefully examining and approving the gun, he asked me if I had any engagement for the following day, and requested me to come over about 2 o'clock, when, he said, 'we will go out and see the thing shoot.'

President Lincoln Tries the Repeating Rifle

"The next day we started on time for the shooting place, which was about where stands the Washington Monument. With us was the President's son Robert and an official of the War Department.

"On the way the President stopped in front of the War Department and sent Robert to ask Mr Stanton, the Secretary of War, to come with us. While we were waiting Mr Lincoln told us some good stories, and, noticing that one of the pockets of his black alpaca coat was torn, he took a pin from his waistcoat and proceeded to mend it, saying, laughingly, 'It seems to me that this does not look quite right for the chief magistrate of this mighty Republic.' Robert reported that Mr Stanton was too busy to accompany us. 'Well,' said the President, 'they do pretty much as they have a mind to over there.' The target was a board about 6 inches wide and 3 feet long, with a black spot painted at each end. The rifle contained six 50-caliber, rim-fire, copper cartridges. Mr. Lincoln's first shot was to the left and 5 inches low, but the next shot hit the bullseye and the other five were placed close around it.

"'Now,' said Mr Lincoln, 'we will see the inventor try it.' The board was reversed and I did somewhat better than the President. 'Well,' he said, 'you are younger than I am and have a better eye and steadier nerve.'"

The reproduction of this interesting relic is from a photograph of the target which Mr Spencer left with the editors. The original is among the war relics at Springfield, Illinois.

Invents the Automatic Turret Lathe

After the war Mr Spencer went to Amherst and was there associated with C. E. Billings, of the Roper Repeating Arms Co., and in 1868 Mr. Billings and he started the Billings and Spencer Co., Mr. Spencer co-operating in the development of the drop-hammer He is still a director in that company. Somewhat later Mr. Spencer invented a machine for turning sewing-machine spools, and this suggested to him that it might be possible to make metal screws automatically. Out of this effort came that great invention, the automatic turret lathe. Joseph Wickham Roe, of Sheffield Scientific School, Yale University, speaking of the device, says: "The

Spencer's automatic screw machine, upon which the screw machine industry is founded

importance of the invention can hardly be over-estimated. It ranks with Maudslay's slide-rest and the turret tool-holder"

A Steam Automobile of 1862

This brief review must necessarily omit mention of many of the inventions and mechanical appliances of Mr Spencer, but a brief description of his steam automobile of 1862 will be of historical interest To an ordinary four-wheeled buggy he added a steam boiler and an engine The boiler was secured at the rear and the engine at the center of the body

The boiler was tubular, vertical and, of course, coal fired. The tubes were made out of rejected Spencer rifle barrels, turned down to the required thickness of shell The engine was two-cylinder, with the cranks set at 90 degrees, the bore being 2½ inches, the stroke 5 inches. Forced draft was obtained by leading the exhaust pipe into the smokestack

There was a chain drive to the rear axle, which rotated Each wheel was provided with a ratchet, and each end of the axle carried a circular flange, and within each flange, engaging the ratchet, were pawls. This arrangement allowed the outer wheel to move faster than the inner wheel in turning a corner So there was one drive forward and no reverse. The steering shaft carried a pinion, which was geared into the "fifth wheel" of the wagon

This steam car Mr Spencer built to carry him to and from his work. On the race track he was able to keep up with the fastest trotting horses. On the road his speed was limited by the rough condition of the surface. The tubular boiler, with its many tubes of small diameter, and the use of the (then) abnormally high steam pressure of 150 pounds to the square inch, was a long step in advance of the current practice of that day

So typical has been Mr. Spencer's life of the ceaseless activity of a born American inventor that we append the following chronological record, following his birth in 1833:

1846. Began study of mechanics, under grandfather, an artilleryman and armorer in the American Revolutionary Army. First work was making a hack saw by nicking an old carving knife on edge of an axe, and with this sawing off grandfather's Revolutionary musket to make a carbine.

1848. Built successful working model of steam engine, 1-inch bore and 2-inch stroke, from information contained in old volume of Comstock's Philosophy

1848-53. Served time as machinist with Samuel Loomis and with the Cheney Brothers, of South Manchester, Connecticut.

1853-54. Served time as locomotive machinist in shops of the Niagara Falls division of the New York Central Railroad at Rochester, New York

1854-57 Served time as gunsmith under Col Samuel Colt at Hartford, Connecticut. Helped to install machinery in present Colt Armory

1857-62. Machinist and inventor for Cheney Brothers, South Manchester, Connecticut Studied drafting under Mr Hezekiah Conant, the Hartford inventor

1858. Invented the automatic thread-spooling machine. This revolutionized the thread industry and brought the Coats Company to America

1860 Patented the Spencer repeating rifle, after three years of experimentation. This was the first dependable breech loading and repeating rifle using metallic cartridges and was the first one to be adopted in the United States Army About 200,000 were issued to the Union Army during the Civil War, and they were used with great effect.

1862. Built and operated the first successful automobile in Connecticut.

1862-65. Superintendent of the Spencer Rifle Company of Boston, Mass., and at the front instructing the troops in the use of the Spencer gun Demonstrated it to and dined with General Grant and Flag Officer Foote on latter's flagship two days before Union fleet ran the batteries at Vicksburg. In August, 1863, taught Abraham Lincoln how to fire the gun

1866. Invented the so-called Spencer-Roper repeating shotgun, first practical repeating shotgun, and founded company to build it at Amherst, Mass.

1868 With Mr Charles E Billings founded the Billings & Spencer Company of Hartford, Connecticut

1868-76 Developed the board drop and various drop forging processes.

1873. Invented the automatic screw machine

1876. With Mr George A Fairfield founded the Hartford Machine Screw Company, at Hartford, Connecticut

1880 Invented the so-called "pump" or "trombone" action repeating rifle and repeating shotgun Founded the Spencer Gun Company at Windsor, Connecticut, to build them

1883. Traveled through Europe with partner, Mr Albert Bierstadt, the artist, and demonstrated the pump gun before the high commands of England, France, Italy, Austria and Germany

1885-1912 Development work upon automatic screw machine and steam automobiles. Invented the Spencer double-end automatic and the universal five-spindle automatic

1912 In eightieth year invented the New Britain six-spindle automatic screw machine

1912 Mechanical engineer at the New Britain Machine Company In 1920, when eighty-seven years old, took up study of aviation and since then has made nearly twenty aeroplane flights.

Steam wagon built by Spencer in 1862, which he used to go to and from work

Metallographic Testing

A SECOND edition of Circular 42 of the Bureau of Standards has been issued on this subject and may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D C

The value of the results of the metallographic examination as related to the testing of metals is now generally recognized While the mere determination of certain mechanical properties may be sufficient in routine testing, for a complete working knowledge of metals and alloys a much more extensive study, particularly of the conditions which determine the properties, is necessary The study of these fundamental conditions, structure, constitution, mechanical and thermal treatment, etc, constitutes the subject of metallography using the term in its broad sense and not limiting it to microscopic examination as was formerly the custom

The circular describes briefly the conditions which affect the properties of metallic materials under the following headings Microscopy and structure, thermal analysis and heat treatment, mechanical working of metals chemical and metallurgical factors, and conditions of melting

The circular summarizes the conditions under which metallographic tests will be conducted by the Bureau, and specific directions concerning shipping, assembling, etc are given

The circular is now ready for distribution, and until it is exhausted copies may be obtained from the Superintendent of Documents in Washington.


A WEEKLY JOURNAL OF PRACTICAL INFORMATION IN ART, SCIENCE, MECHANICS, CHEMISTRY AND MANUFACTURES

VOL. VI.—NO. 4. NEW YORK, JANUARY 25, 1862. NEW SERIES.

Improvement in Breech-Loading Rifles.

The Devotion of Agassiz to Science.

Fig 1. Fig 2. Fig 3. Fig 4.

SPENCER'S BREECH-LOADING RIFLES.

Details of the first successful repeating rifle, as shown in the Scientific American of Jan. 25, 1862

News and Music from the Air

What the Radio Telephone Means to the Farmer and Business Man at Home and at Work

By Pierre Boucheron

WHAT is the most unique yet withal fascinating hobby of modern times? A safe guess, surely, is the radio telephone. To conceive of thousands of boys, young men and grown ups throughout the United States using the same medium to talk with one another in much the same manner as a roomful of people at a reunion or large sized assembly, to listen at given intervals to concerts where all manner of instrumental and vocal performances are faithfully reproduced, to intercept the news of the nation as broadcasted by various central stations in the larger cities, to receive timely and valuable agricultural reports of importance to farmers—all this constitutes an achievement that may well be called the hobby of hobbies. The achievement is still more important when it is considered that these radio telephone activities are a product of the resourcefulness and inventive genius of the American youth. Helped along by our judicious yet liberal laws for the control of amateur wireless activities, this pastime has grown in a few years from one of a few hundred followers to one of several hundred thousands. To be exact, there are approximately 300,000 amateur wireless men in the United States today.

One phase of the wireless hobby that is by far the most responsible for this rapid growth is the rapid and successful development of radio telephony. It is true that amateur wireless telegraphy has been an American institution for the past ten years or more, but the art in the past has been largely confined to professional telegraphers or to those who had the time and patience to master the art of sending and receiving the Morse or Continental Codes. Many boys and young men were attracted by the initial fascination of communicating without wires, but unless they were willing to devote a certain amount of time, say a year or more, to systematic telegraph practice, the art soon lost its charm since there was not much amusement in listening to rapid and meaningless dots and dashes. The war, which has been blamed for so many ills, did one good turn for amateur radio by training many men in its use and by developing the radio telephone to a remarkable point of operating efficiency. These trained men went back to civilian life and to amateur radio. Incidentally, they spread the gospel to others, with the result that we have today a formidable army of enthusiasts, more characteristically known among themselves as "bugs."

The radio telephone soon appeals to the average citizen after a brief acquaintance with its possibilities, indeed, that is why, where formerly none but schoolboys played with radio telegraphy, today all manner of professional men and even women have joined the ranks of radio telephone operators as an indoor pastime. This is not strange when one considers the fact that with an inexpensive receiving set erected in a few hours' time, one is soon "listening in" on the doings of the world, so to speak. Not listening in as an eavesdropper, mind you, for wireless conversations are of the informal, good-fellowship kind—harmless, instructive, and as interesting as an open forum.

To get back to more general radio matters, there are in the United States three broad classes of radio telephone activities, as follows:

1. Commercial radio telephony.
2. "Wired-Wireless or radio applied to wire systems.
3. Amateur radio telephony.

The first class or phase, commercial radio telephony, holds considerable promise for the immediate future, although at present its scope and exact usefulness are not quite as clearly delineated as the amateur application. Moreover, when placed on a commercial basis, the initial expense and maintenance are necessarily higher than for amateur requirements. Adjustment of the apparatus and test periods must be reduced to a minimum, for time plays an important factor as compared with the amateur who has plenty of time at his disposal. The present land line telephone does everything that the commercial radiophone is capable of doing, with the possible exception of radio telephone service to ships at sea. Then, too, there are other special cases where it could be used to excellent advantage. Simplicity of operation and absolute reliability at minimum cost are therefore the factors with which future development must concern itself to make commercial radio telephony popular. To this end, the engineers of the largest radio corporation in this country are now engaged in perfecting several standard radio telephone sets, each designed for a specific purpose, ranging from small- to high-power outputs.

"Wired Wireless," a somewhat paradoxical expression, applies to a recent development where radio principles are used in long-distance wire telephony and telegraphy. Quite effective multiplexing is made possible by the use of radio waves which are guided by wires already in use for other purposes. In fact, from six to ten simultaneous channels of communication are sometimes available on a single land line wire. The "wired wireless" telephone may be used in conjunction with present power transmission lines, steam and electric railway tracks, metal fences, and so on, thus proving valuable and economical to central power houses, sub-stations, and to telegraph and telephone trunk line systems. Incidentally, we may reasonably look forward to future transoceanic cable telephony through the application of the "wired wireless" principle.

But amateur radio telephony is easily the most popular application of the radio telephone up to the present time, because, as previously outlined, it finds ready application for a variety of purposes which at once become interesting and fascinating for social intercourse, as a scientific hobby, or for the broadcasting of information and music.

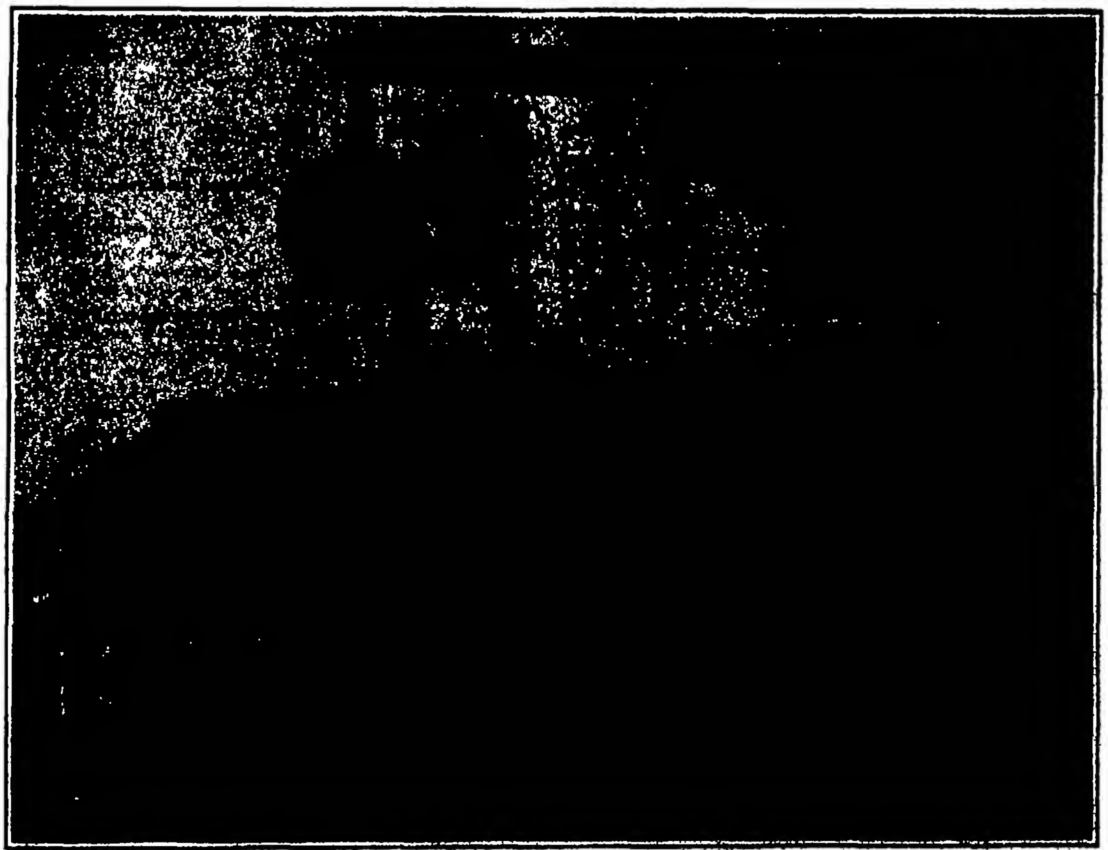
As an illustration of the importance which the United States Government attaches to the amateur radio telephone, the Agricultural Department is considering its use to replace the present radio telegraph broadcast system which covers about half the country. This existing system, by the way, was started April 15 of this year from air mail radio stations at Washington, Cincinnati, St. Louis, Omaha, North Platte, Neb., Rock Springs, Wyo., and Elko and Reno, Nev., each one of these stations having a radius of 300 miles.

At eight o'clock each morning, market reports covering grain and livestock, fruits and vegetables, are transmitted by regular wire to the above-named air stations. From these points, together with local market reports, they are sent broadcast by radio telegraph. Anyone equipped with simple receiving instruments may pick up these reports with little difficulty; and, consequently, their value to farms, in banks and in commercial clubs has been fully appreciated, more and more receiving sets being installed throughout the country.

The difficulty with the Government's broadcasting is that it is done by radio telegraph, so that the signals can only be read by persons proficient in copying Morse code. While the messages are copied by eager enough local amateurs, there are not enough of them to permit broad application of the service. The radio telephone, on the other hand, will enable any farmer equipped with a moderate-priced receiver to take advantage of the service.

To this end, when the Government Departments are reorganized all communication matters such as these radio agricultural reports, which now are handled jointly by the Agricultural and Post Office Departments, will probably be brought under the jurisdiction of the Post Office Department. In fact, a post office official recently sailed for Europe to seek ideas bearing on the establishing of an extensive radio telephone stock market and weather report service to be operated by the Government. This contemplated service will shortly be available to every farmer in the country who cares to make the small investment required to purchase the necessary receiving apparatus.

While this Governmental interest in the value of the radio telephone is steadily thriving, private organizations are planning unique broadcasting services of their own. Two large companies have already established powerful radio telephone stations at certain centers, from which they send out news at stated intervals in addition to frequent concerts. Perhaps the greatest and most striking demonstration of this news-reporting method was the one staged at the recent Dempsey-Carpentier boxing match, when more than 300,000 "ear witnesses" listened to the reports of the fight round by round. The station was located at Hoboken, N. J., and the power of the radio telephone set employed was sufficient to reach amateurs within a circle of several hundred miles. The latter quite



Typical amateur transmitting and receiving radio telephone set, showing the different pieces of apparatus arranged on a simple wooden bench

company which reported the big fight [illegible] to report future national [illegible] much the same manner

[illegible] it is true that the American amateur was probably the first to put the radio telephone to practical use, foreign countries are also planning popular broadcasting [illegible] An instance is to be found in Germany, where the government has taken a hand by broadcasting stock exchange news, weather reports, etc. In fact, the German Government is now building 1000 standardized receiving sets which the Government itself will place in various banks and business houses throughout Germany for the reception of this broadcast service The German Government also proposes to send out from one of its powerful stations the music from the State Opera House in Berlin.

In addition to the boys, young men and engineers who have been drawn to the ranks of the amateur radio telephone, there are the business and professional men, many of whom are prominent and well to do They have read in the press and magazines of the fascination and achievement of wireless, and their interest has been aroused to the point of actually installing receiving equipment in their homes as well as on their private yachts, with the view to operating the sets themselves.

The vacuum tube, often referred to as the modern Aladdin's lamp of radio, is largely responsible for the present day efficiency of the radio telephone as contrasted with the pioneer experiments of early investigators back in 1906, who employed the singing arc lamp as a generator of the required high frequency undamped oscillations. Today all that is required to produce wireless speech is a simple enough electrical circuit employing one or more vacuum tubes and several necessary accessories. A 100-foot antenna and a suitable grounding connection are easily installed, and these simple devices are sufficient for transmission and reception purposes The matter of distance is entirely dependent upon the number of tubes and the power used, as well as the proper adjustment of the apparatus. It is not within the province of this article to give complete specifications. Inquiring of any radio supply house or manufacturer as to parts and prices is, after all, a most effective way to secure definite information

Briefly, to erect a small receiving set capable of intercepting wireless telephone conversations, concerts, Government reports, etc, the cost need not exceed $25 00 as an initial expense The cost of erecting a combination sending and receiving station, however, will be considerably more, since transmission entails the use of greater power Several hundred dollars should be sufficient for a sending and receiving station If one is going in for wireless telephone transmission as well as reception it will be necessary to secure a station license as well as an operating license from the Radio Inspection Bureau of the Department of Commerce, whose representatives are located at all important cities.

Judging [illegible]-day development, there [illegible] that a few brief years [illegible] and popular use of [illegible] practical application [illegible] so to speak [illegible] anyone possessing the [illegible] apparatus The [illegible] is new and will continue [illegible], the service being maintained by manufacturers of apparatus [illegible] and service feature. The [illegible] will be equipped with a [illegible] unit suitable for any [illegible] of wire will serve [illegible] antenna, picking up the [illegible]. Concerts will be heard, [illegible] sermons will be preached on [illegible]. Of course, all this transmission [illegible] at certain central stations [illegible] citizen will simply turn on [illegible] at scheduled hours and the radio [illegible] in somewhat the [illegible] as the usual cabinet talking machine. Indeed, there is nothing of the [illegible] about this statement, for the thing has almost come to pass.

Commercial radio telephone transmitter, employed in broadcasting work Note that the operator speaks into a standard desk-type telephone instrument

The Mechanics of Ordnance Figures

ACCURACY to the fineness of a few millionths of a second and the capacity for producing a flash of light within a duration not exceeding 0 00001 second are among the features claimed for a new timing device developed by the United States Bureau of Standards Veiled as a secrecy in relation to the gun firing investigations of the Bureau of Ordnance Navy Department during the war, only its recent disclosure accords the instrument recognition in measuring any small time interval which may be recorded electrically

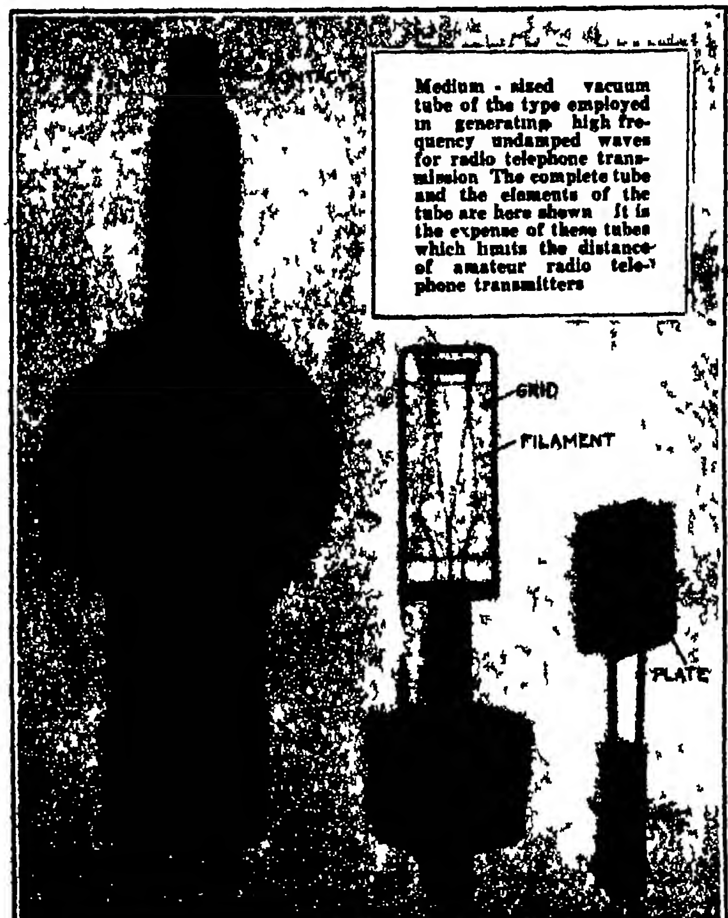
So arranged that an electrical oscillograph may be attached thereto, the apparatus serves the specific purpose of determining ejection velocities of each projectile fired from a ship The oscillograph is composed of a high frequency, critically damped galvanometer arranged with an optical system whereby the galvanometer deflections are recorded upon a moving photographic film Variations of the current through the galvanometer are reflected upon the photographic record at a negligible lapse of time Each oscillograph is equipped with three galvanometers which can be employed independently For example, during the firing of the U S S New Mexico two, three or four oscillographs were used at the same time to record the measurements taken during the various [illegible] salutes

Such impressions of oscillograph records are taken on a photographic film 60 inches long by 3½ inches wide conveyed on a drum 60 inches in circumference Fastened to the oscillograph the drum is in continuous rotation while the film exposure is being made. Operating electrically the closing of one switch will energize electro magnets which open the oscillograph shutter and close it again after the drum has made a complete rotation. The use of a film 60 inches long permits the the taking of an impression of sufficient duration to record the complete recoil and counter recoil of the gun without appreciably condensing the time scale Three-eighths of an inch represents 0 01 second, an unit of measurement determined on the film [illegible] to record on a [illegible] the events which transpire [illegible] the projectile is in the gun than heretofore In noting the impressions the speed of the film is described as being ⅜ of an inch representing 0 001 second

Insufficient intensity of light has hitherto been a retarding factor in determining the ejection velocity of a projectile Consequently, the Bureau of Standards designed and constructed a special arc lamp whose beam of radiation is from six to eight times the intensity of the light reflected from the ordinary oscillograph arc lamp The latter is made rigid by fastening both it and the oscillograph to a table Knockdown tables are used in facilitating the handling of the apparatus and equipping a laboratory aboard ship each unit comprising a switchboard and requisite switches for operating oscillographs

A timing system peculiarly adapted to the purpose for which it was developed is grooved into each oscillograph, whereby the moving photographic film is ruled into equal time by allowing flashes of light from the arc light to fall upon it at specified intervals A thin slotted aluminum plate is mounted on each prong of a tuning fork so that the plates overlap

The fork is mounted in the oscillograph and the plates adjusted so that when the fork is not vibrating the slots are in line with a beam of light an optical system first condensing the light from the arc upon the slot and then throwing it in a narrow line across the film With the fork vibrating the slots are in line with the radiation twice each vibration thereby insuring twice as many flashes on the film to the second as the fork makes complete vibration during the corresponding time These forks are driven by a 100-cycle master fork which carries two contacts. One is employed in driving the fork itself, while the other is connected in series with the magnet of the 500-cycle fork and a source of 110 volt d c power The magnet of the 500-cycle fork is therefore energized 100 times per second or once every five vibrations of the fork itself Careful tuning renders it feasible to drive the fork with a total amplitude of 0 06 inch Considering that the slots are only 0 004 inch wide the amplitude of vibration produces flashes of light of an infinitely brief duration—an examination of the film determining the time element of the flash not exceeding 0 00001 of a second



Medium-sized vacuum tube of the type employed in generating high frequency undamped waves for radio telephone transmission The complete tube and the elements of the tube are here shown It is the expense of these tubes which limits the distance of amateur radio telephone transmitters

Oil Shale in Palestine

ON the shores of the Dead Sea and west of that sea between Jerusalem and the vicinity of Nebi Musa, is found a peculiar stone The stone, which is abundant is commonly used by the local people in making souvenirs It is a matter of common knowledge that the Bedouins have used this stone for several years as fuel, and it is reported that during the war it was so used by the Germans It is said that the latter also extracted oil from it The stone is called Dead Sea stone and Stinkstein In the Yarmouk Valley in northern Palestine are also found vast quantities of an oil impregnated shale.

General view of the Savenac Nursery seed beds, Lolo National Forest, Mont.

Our Reforestation Activities

Some Facts and Figures About Tree Planting on a Gigantic, Yet Still Insufficient, Scale

By Charles Frederick Carter

NOW that a comprehensive program for forest conservation has been formulated for the first time and submitted to Congress as the Snell Bill, a brief inventory of our forest resources today and a summary of the efforts now being made to provide for the needs of tomorrow should be of interest, although such a survey is hardly flattering to the National vanity.

It is now forty-eight years since Congress first took cognizance of the necessity for Governmental action to conserve the Nation's forest resources by the passage of the timber culture act of 1873; thirty years since the first forest reserve law, designed to protect the sources of streams, was enacted, and twenty-four years since recommendations of the National Academy of Sciences, submitted pursuant to request from Congress, were formulated into what then seemed an adequate National forest policy. All this time we have continued to squander our forest resources with the prodigal folly of the proverbial drunken sailor until at last we are confronted with the knowledge that they will be exhausted within a few years unless heroic measures are applied at once.

Figures from the National Forest Service fix the total original forest area of the United States at 822,288,000 acres, of which there remain approximately 463,000,000 acres of nominal forest. But only 30 per cent, or 137,000,000 acres, is virgin forest. The rest includes 112,000,000 acres of second-growth saw timber, 33,000,000 acres of second growth below saw timber size, and 81,000,000 acres which have been devastated by wasteful methods of cutting and by repeated fires, on which nothing of value is growing or likely to grow without a huge expenditure for reforestation. This totally devastated area is equal to the combined areas of France, Germany, Belgium, Holland, Denmark, Switzerland, Spain and Portugal. Besides the waste land there are approximately 245,000,000 acres bearing second growth forest. In a large part of this forest wasteful cutting or excessive grazing have reduced production to a mere fraction of what it might be with proper handling. To convert such lands into valuable producing forests will in many cases, involve expenditures as great as if the lands were devastated.

Of the meager remnant of merchantable timber at least 5,?00,000 acres are cut over each year, and they are cut over much more closely than formerly, with the result that after fires have killed out most of the young growth there is little or no chance for reproduction to start.

Destruction from various causes diminishes the visible supply even more rapidly than use. From 1916 to 1918 an average of 6,400,000 acres of forest land were burned over each year, and in 1910 and 1919 the area was considerably larger. Storms, too, take their toll, a single cyclone on January 27, 1921, cutting a swath through the magnificent forest on the Olympic peninsula 30 miles wide and 75 miles long, destroying 8,000,000,000 board feet of timber. Then the black pine beetle is destroying timber by the billions of feet in the Pacific Northwest.

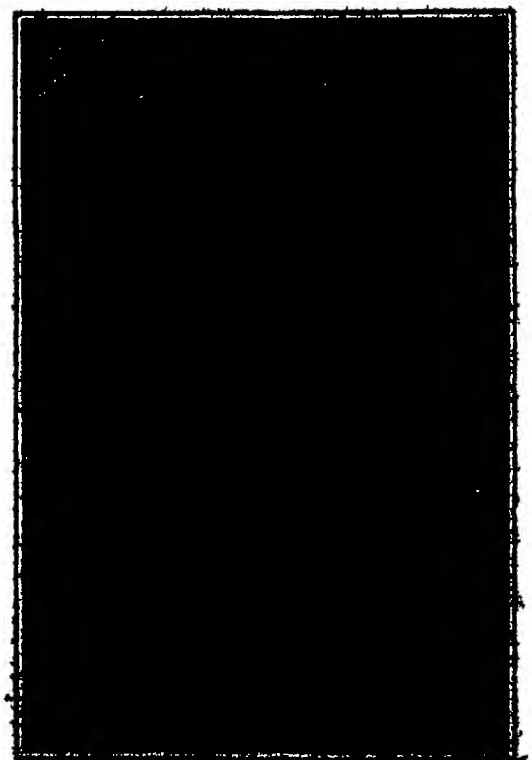
Stated in another way, timber is being cut at the rate of 26,000,000,000 cubic feet a year, or more than four times as fast as the new timber is growing, while that of saw timber size is being cut and destroyed by fire, disease and insects at the rate of [illegible] board feet a year, or more than five and a half times the growth of such material.

In view of such facts as these, efforts to conserve what timber is left and to provide for the future assume a lively interest, for the physical and economic well being of everybody is intimately associated with adequate forest resources.

It is, perhaps, only natural that the uninitiated should imagine that forests would have to be restored by planting. Data from the U. S. Forest Service show that a total of 170,000 acres have been planted by the Service up to the end of June, 1920; 85,000 acres additional by the State Forestry Departments, and 850,000 acres by private individuals and corporations in 19 states. Adding the estimated planting in Nebraska, Kansas, Illinois, the Dakotas, Missouri and Oklahoma would swell the private planting to a total of 750,000 acres, or a little more than a million acres planted by all the agencies that have been operating in this field in the United States, from the time when planting was first undertaken by the western settlers forty or fifty years ago, right down to the present time.

The Snell Bill appropriates $1,000,000 yearly for five years for reforesting denuded lands in the National Forests. As the average cost of planting is $10 an acre, this would provide for the reforesting of 100,000 acres a year. This is regarded as the maximum practi-

Planting crew setting out yellow pine, Pike National Forest, Colo.



[illegible]

[illegible] by the National Forestry Program Committee representing professional foresters and a large number of organizations interested in forest conservation, although an ideal program would be 1,000,000 [illegible] carried on [illegible] for 81 years. [illegible] the 81,000,000 acres of [illegible] denuded land which should be growing timber both because it is needed and also because this land is fit for nothing else would require at the rate provided for in the Snell Bill 320 years and an [illegible] outlay of $810,000,000. Now about 130 years are required to produce good merchantable saw-timber, and 30 to 40 years to [illegible] pulp wood. If compound interest be computed on the capital required for such an undertaking for 40 to 130 years the unsophisticated may begin to understand why tree planting as a process of restoring forest lands is relatively a minor matter in the minds of foresters. A forester never plants trees if he can get Nature to do it for him. Furthermore, Nature, if given half a chance, will usually do it. Planting is the most expensive method of establishing a new stand of timber. It involves a relatively high initial investment which must be carried at compound interest during the entire period required for the timber crop to grow to merchantable size and to be harvested. When it is remembered that the 81,000,000 acres referred to as utterly denuded is but a fraction of the total acreage requiring attention it will readily be seen that something besides planting is required if the country is to have a timber supply at all commensurate with its needs a few years hence.

That something is fire protection. According to a statement by Col. W. B. Greeley, Chief Forester, of the U. S. Forest Service, 30 States contain approximately 325,000,000 acres of timbered and cut over land in State and private ownership requiring protection from fire, which is the first step toward providing a continuous supply of timber. Of this area 175,000,000 acres are almost wholly unprotected. There are from ten thousand to twenty-five thousand forest fires every year which destroy the young forest growth on eight to ten million acres every year, aside from large areas burned over annually of which no record can be obtained.

Effective protection of these 325,000,000 acres of forest land, according to Col. Greeley, lies at the bottom of any National policy of reforestation. Once this vast area is really protected from forest fires, three-fourths of our timber supply problem will be solved.

Since 1911 the U. S. Forest Service has cooperated in fire protection work in 10 to 25 States, expending from $40,000 to $125,000 per year of Federal funds. In that period State and county expenditures have increased from about $250,000 a year to more than a million dollars while private expenditures have increased six or eight fold.

The cost of protecting forest lands from fire as reported by 26 States averages 2½ cents an acre. A forest protection budget for the United States, excluding National forests, would thus aggregate about $8,125,000 a year, whereas the sum regularly available aggregate $1,[illegible], of which State and county appropriations represent $1,000,000, private expenditures $700,000 and the Federal appropriation [illegible]. In other words, only about 25 per cent of the necessary task of protecting forest lands from fire is being done today.

"[illegible] fires, particularly [illegible] for lightning," [illegible] Forester R. [illegible] not by [illegible] can [illegible] eliminated [illegible]

Tree-planting in the Nebraska sand hills, showing furrows in which young trees are planted

caused fires in cities. In its essentials the problem of forest fires differs only in degree from the problem of man-caused city fires. The first essential is the recognition by every one of the danger and of the community loss from forest fires. The second is an organization to put out those which do occur while they are yet small. In some regions recognition of the serious loss to the community as well as to the land owner resulting from forest fires has not been developed. As a result fire fighting is more costly than will be necessary after the public is aroused. In some of the Western National forests a smaller force is now needed for fire protection just because the local public has acquired a more enlightened point of view regarding forest fires and has acquired the habit of being careful while in the woods.

Forest fire protection, in my judgment will reforest or keep cut-over land growing forest on hundreds of acres for every acre that has been or is likely to be reforested by planting. If fire protection alone will not restock the land with a new crop of trees a new crop can in many places be secured by leaving seed trees or in some types of forests by leaving the smaller trees when the mature crop is cut. Planting will have to be resorted to to reestablish forests on areas so badly burned or recklessly cut that a new crop can not be obtained by natural seeding.

"Part of the 81,000,000 acres so devastated by reckless cutting and by fire that it is no longer productive will have to be planted. Fire protection alone will restore the remainder. There will be little excuse for extensive planting outside these devastated areas. The exceptions will be where the need exists of securing quick indirect benefits such as the prevention of erosion, or in the Nebraska sand hills, or where local economic conditions justify extra expense to assure full stocking quickly."

The Snell Bill appropriates $1,000,000 a year for fire protection in cooperation with States and through them with private agencies. In the Pacific Northwest there are some thirty organizations of timber owners cooperating with each other and with the State and Federal Governments in fire protection. In Oregon and Washington laws have been passed making patrol of privately owned timber lands compulsory. Private contributions sometimes amount to as much as 20 to 30 cents an acre a year. The private owners also take care of a large proportion of denuded and restocking lands regardless of whether it belongs to them or to the Government. In this territory natural reproduction is swift and sure if fire is only prevented from undoing what nature so laboriously accomplishes.

The Snell Bill also appropriates $10,000,000 a year for 5 years for acquiring additional lands for National forests, which on June 30, 1920, aggregated 156,032,053 acres and which are intended to be conservation areas as well as a protection for watersheds. The Bill appropriates a grand total of $71,250,000 distributed throughout a term of five years, the purpose including in addition to those already mentioned a survey of the forest resources and timber requirements of the Nation and forest research investigations in wood utilization and a study of forest taxation the effort being to distribute fairly the other forest expenses as well as the forester's share of ordinary government expense.

Among the States New York leads in reforestation. Not only does the State produce about 5,000,000 trees a year for reforestation but paper mills and railroad companies maintain their own nurseries. From 1908 to 1920 the State planted 60,000,000 trees which at the usual average of 1,000 trees an acre means 60,000 acres replanted. In 1920 the State planted approximately 8,000,000 trees while private owners planted 3,000,000 trees on cut-over land.

Massachusetts has been carrying on an active reforestation program for several years. Recently the State acquired 100,000 acres to be restocked as rapidly as nursery stock can be grown.

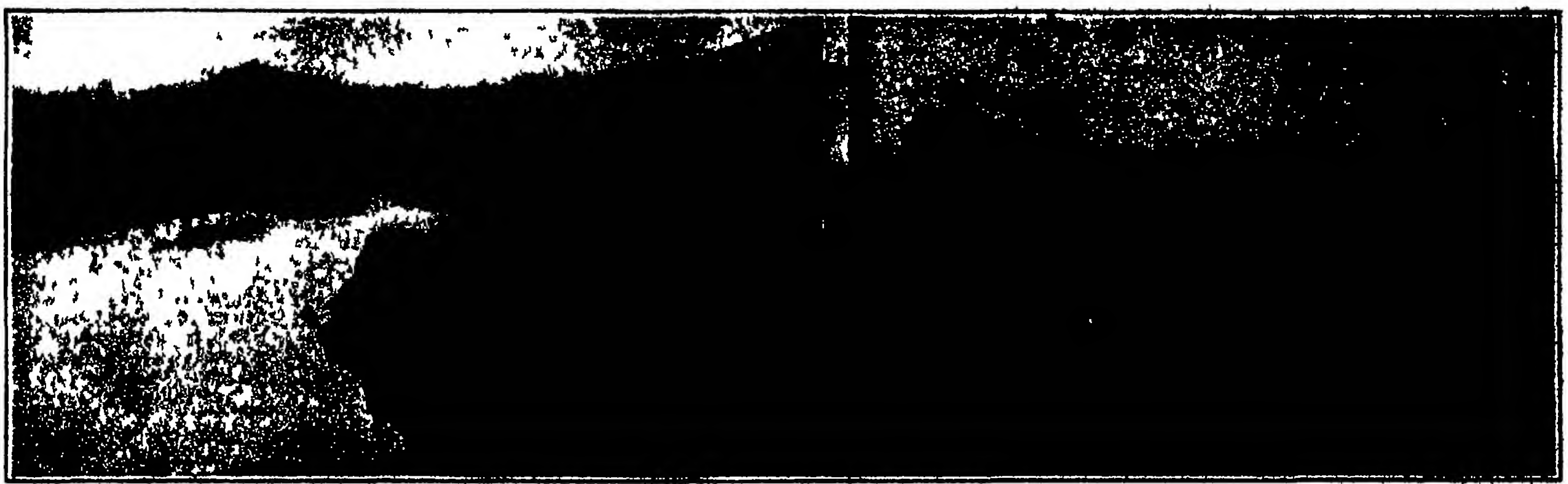
In the South Louisiana leads in reforestation. A single lumber company has planted 3,000,000 trees. The lumber companies have united in conducting extensive educational campaigns in the schools. The State Department of Conservation has just started a competition for boys clubs in planting and caring for trees. Texas is not far behind Louisiana.

Michigan planted 4,000,000 trees on State lands in 1920. Minnesota has done some reforestation but the principal activities of the State have been in fire protection. Kansas and Nebraska have done considerable planting to check drifting sands in the West and the work has been notably successful. Florida, Missouri, and Ohio have recently enacted laws providing for reforestation. Most of the other States have done or are preparing to do something in the way of reforestation but not yet on a scale large enough to be really effective.

Broadcast seeding on high ridges in the wake of forest fires, Olympic National Forest, Washington

Oriental Demand for American Lumber

JAPAN imported 77,000,000 feet of American lumber in 1920 according to a report appearing in the *Japanese American Commercial Weekly*. A material reduction in prices, a decrease in freight rates, and the recent great fires in Japan are considered grounds for the belief that this demand will increase to about 100,000,000 feet in 1921. While the normal export of lumber to China amounts to about 200,000,000 feet annually that of 1920 came to only 155,000,000 feet though greater activity is expected in this market this year. A striking difference between the trade with Japan and China lies in the fact that while the former country buys practically all lumber for remanufacture the latter imports lumber in manufactured form.



Left: A glimpse of the phosphate fields of the Mountain States, which latest Government surveys estimate to contain more than six billion tons of high-grade rock. *Right:* Phosphate mine in Florida, the state which has always supplied the bulk of the rock used in fertilizers

Phosphate resources of the United States

Phosphorus, the Backbone of Life

America's Great Deposits of This Chemical for Fertilizers and Through Them for Food

By George H. Dacy

DESPITE that the United States includes within her borders the greatest phosphate mines in the world we have failed lamentably up to this writing in making the most efficient and effective utilization of these valuable mineral deposits. True, subsequent to the Civil War—it was in 1862 that the phosphate deposits in South Carolina were first discovered—we began to develop our phosphate resources and extended the industry gradually to Florida, Tennessee, Arkansas, Kentucky, Utah, Idaho, Wyoming and Montana, but in the mining and utilization of this natural heritage we have pursued extravagant, wasteful methods. In some instances as much as two thirds of the phosphate which is mined is washed away onto the dump piles in order that the marketable product may be of the finest grade and quality.

Fertilizer economists, of course, argue that the washings and tailings which are run out on the dump heaps are not legitimate wastes until some practical method is devised of separating the mineral from its impurities. Albeit, if these phosphatic losses are compared with those occurring in the mining and smelting of metalliferous ores they appear little short of rash folly. Metallurgical practice has now been developed to a stage of perfection which admits of working over old dump heaps and tailings containing only a fraction of one per cent of the desired mineral with economic success. From an industrial standpoint, it therefore is criminal that material and byproducts containing from 12 to 18 per cent of marketable phosphorus should be heedlessly thrown away just because the ingredients are relatively low priced.

The manufacturer of iron or steel would hardly conceive of a condition where his finished product would contain less of the marketable ingredient than the ore from which it is derived, while to ship and reship material from place to place under conditions of almost prohibitive freight rates while the percentage of its valuable ingredient was constantly being decreased would appear like industrial suicide to the average layman. Nevertheless, that is exactly what is done in the phosphate industry, an industry which is the backbone of the fertilizer business and the fundamental basis of the agricultural wealth of a considerable portion of the Eastern and Southern States.

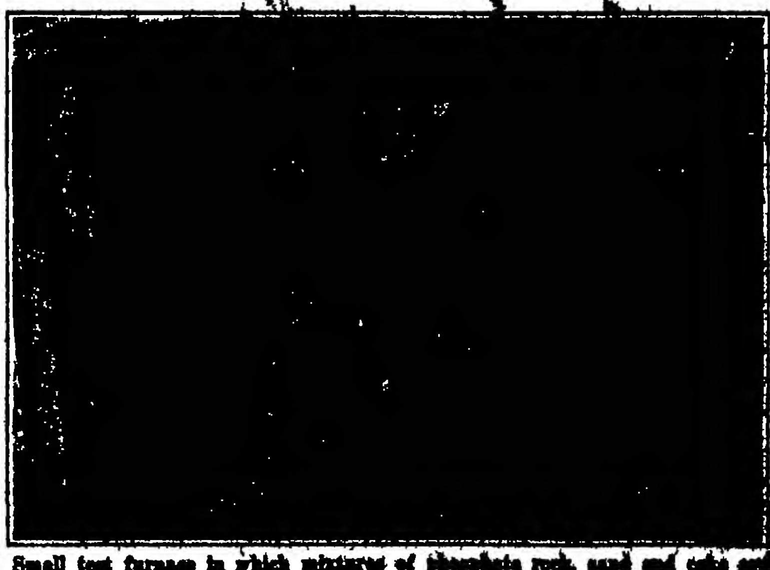
After the high grade phosphate rock is recovered as a result of elaborate washing and screening processes it is shipped long distances to fertilizer factories where it is treated with an approximately equal weight of sulfuric acid and manufactured into acid phosphate which ordinarily contains about 16 per cent of phosphoric acid—less than 50 per cent of the amount contained in the original rock as it comes from the phosphate mine. Thereafter this low-grade product is again shipped long distances to fertilizer mixing plants or to the farmers — the ultimate users of this fertilizer. The purchasers are obliged to pay freight, labor and handling charges on 84 per cent of natural or artificial filler in this commercial fertilizer. By the time the fertilizer is finally distributed over the sick, ailing or over worked fields, these costs have aggregated to quite a sum. Agricultural scientists admit the necessity for diluting concentrated phosphatic fertilizers before they are used as a tonic for farm crops, but they contend that it is an unnecessary and wasteful extravagance purposely to manufacture low grade goods far from the points of consumption when the filler of diluting agent could just as well be added to the original concentrated material on the farm where the products are used.

Apparatus for the electric precipitation of phosphoric acid

Every effort of the national Department of Agriculture and the various state agricultural agencies is—at present—directed toward the reformation and standardization of the phosphate mining and manufacturing business so that hereafter phosphoric acid may be marketed with the least possible waste of time, money and material. Some prominent phosphate plants have already been re-adapted to these new and economical practices. Instead of marketing the traditional varieties of 16 per cent acid phosphate, they are distributing products containing up to 50 per cent of phosphoric acid. One concern has placed on the market a compound of ammonia and phosphoric acid which contains large enough amounts of these two fertilizing elements to permit of its economical transportation to far distant points.

An enormous loss of valuable phosphatic materials annually obtains in the Florida mines which market about 2,000,000 tons of phosphatic rock a year. Heretofore, from 50 to 65 per cent of this supply of phosphatic acid was wasted due to insufficient methods of separating the impurities from the valuable fertilizing mineral. Uncle Sam, through the experiments and investigations of his Bureau of Soils, has demonstrated recently that this great loss of phosphate entailed in mining Florida rock may be largely eliminated by mixing the 'run-of mine' phosphate with sand and coke, and smelting the mass in either an electric or a fuel fed furnace. In this process the phosphoric acid is driven off as a fume and may be readily collected in a concentrated form. Although additional research work must be instituted and completed before all the minute mechanical and chemical details have been solved satisfactorily, the operations bid fair to prolong the life of our phosphate deposits for an indefinite period.

According to the most recent surveys and estimates of the U. S. Geological Survey, the phosphate fields of Utah, Idaho, Wyoming and Montana exceed in tonnage the total output of all our other fields. The government experts figure that these new deposits contain more than 6,000,000,000 tons of high grade phosphate rock as well as many times this amount of low grade phosphates. Not only does this country own the largest phosphate deposits in existence but we also mine and manufacture more of this fertilized material than any other country. In addition to supplying our domestic needs, our active mines also export anywhere from 500,000 to 1,000,000 tons annually. A considerable part of our annual production is ground finely and applied over agricultural fields in that form but the vast bulk of the rock is treated with sulphuric acid and converted into acid phosphate, the foundation of commercial fertilizers.



Small test furnace in which mixtures of phosphate rock, sand and coke are smelted at high temperatures, and the phosphoric acid distilled out and collected

Why Weary Metal Fails Under Light Loads

The Causes of Steel Fatigue, and the Ticklish Problem of Testing Against It

By George H. Dacy

A MOTOR truck accustomed to handling loads of six to ten tons may collapse due to axle failure when the only burden the machine is carrying is the driver. A street car which handles 100 passengers during the peak traffic hours of the day may wreck due to axle or wheel collapse when it is returning to the car barn to be greased. An elevator which is adapted to carry 20 persons may crash to its basement pit when empty. Even bridge girders which have been designed to support enormous stress and strain may break down under light loads. Not infrequently serious automobile, street-car, elevator and bridge accidents occur which result in heavy losses in limb and life just because some of the metal parts used in the construction of the vehicles or bridges have become so tired that—without warning or outward evidence of portending collapse—they give way. These untoward phenomena for years have presented perplexing and puzzling problems to the engineering fraternity, which has done everything possible along technical and scientific lines to reduce the risk and solve the riddle connected with metal fatigue.

A—Electrically-heated furnace. B—Water-quenching tank. C—Oil-quenching tank. D—Oil-circulating pump

Laboratory apparatus for reproducing the conditions of heat treatment

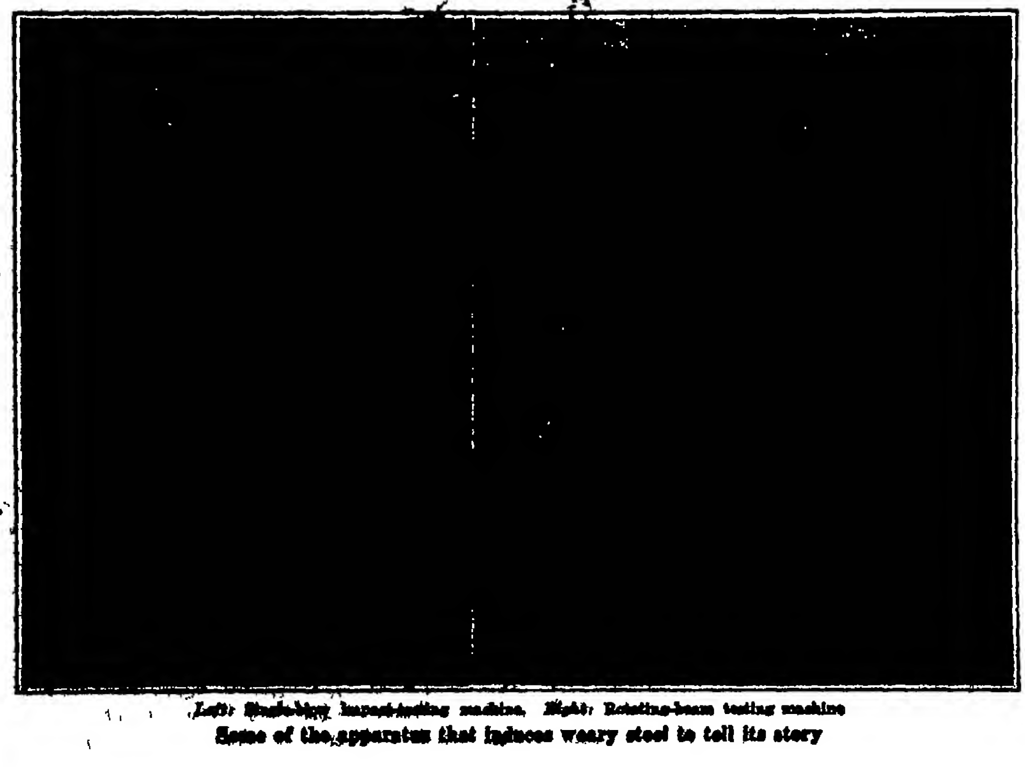
Under the joint auspices of the Engineering Foundation, the National Research Council, the General Electric Company, and the University of Illinois Engineering Experiment Station, invaluable investigations are being conducted at Champaign, Ill., over a two-year period to ascertain accurately the limit of endurance of a wide range of samples of iron and steel. Heretofore, frequent experiments have been carried out to determine metal durability under the strain of a single load. The purpose of the current investigations is to find out conclusively about fatigue strength under frequent loadings. Novel and unique testing machinery, which under laboratory conditions over a short period submits the metal materials to stress and strains such as they would be exposed to during many years of service usage, has been designed expressly for the purpose of clearing up the intricacies which, previously, have obscured the engineer's knowledge concerning the everyday history of steel and metal materials and their reactions to continuous service.

A modern Goliath of professional weight lifters for many years may excel all his rivals in remarkable feats of strength. Then due to excessive use of certain muscles or on account of old age, he may begin to slow up; his muscles are unable to respond so adeptly to the dictates of his will. He has to reduce the weight of his dumb bells, bar bells and cannon balls. Gradually, he fails in health and strength and ultimately, he is obliged to abandon his exhibition work. Now unlike the human metabolism, the strength of metals gives way all of a sudden without any indication of impending failure. The line shaft in a machine shop may have been in active service only a few years and appear as good as new—yet, unexpectedly, it may fail and cause a costly and serious accident. Similarly, the steering knuckle or crankshaft, springs, axles or engine parts of the motor car apparently may look fit and strong yet under service when the driver least anticipates a breakdown, one of these parts may disrupt. That is why the need is urgent for some method of standardized testing which will admit the prediction of the actual use and strain which the different metal materials will survive. Vital statistics are needed which will forecast the lifetime of steel and iron so that approaching failures may be noticed and guarded against.

Studies of why metals under light loads, frequently repeated, failed more rapidly than they did under heavier burdens of a more uniform pressure have been in progress for the last 60 years. German scientists conducted many tests and devised methods which are incomplete when measured in terms of modern machinery, mainly because they are of such short duration and because since those tests many new kinds of steel have come into use and new metals such as aluminum are available for building machines. The inadequacy of these investigations led to the conception of the series of strength tests devised by Professor H. F. Moore and his talented assistants. Any metal that survives these tests merits a distinguished service cross denoting special strength superiority. These middle western engineers have devised tests which expose the metal samples to every conceivable stress and strain under regular repetitions.

Metals while being subjected to fatigue in these experiments have been observed under the microscope and it has been found that the crystals of which a metal is composed will allow deformation to occur by movement along certain gliding planes within the crystal. This gliding or slipping is indicated by the appearance of lines running across the crystals. They are called "slip bands" and careful examination has elicited the facts that the slipping causes microscopic ridges and depressions of the surface, in the nature of steps. As the test of the material fatigue is continued, the slip bands become more numerous, and also broaden. Finally, some of the bands develop into a crack which spreads to other crystals and thus causes failure. Therefore it appears that the primary cause of fatigue failure is localized deformation. Because steel is composed of many minute crystals—in ordinary steel there are at least two different kinds—the structure is not likely to be homogeneous. Furthermore, there are likely to occur many microscopic flaws throughout the material. Hence somewhere in the sample, there will be high local stresses due either to non-homogeneity or to flaws, and at such points, the sample will be liable to deteriorate by the repeated action of fatigue stresses. The presence of internal stresses, due to previous heat treatment or mechanical treatment, would also tend to weaken the material when fatigue stresses of a similar character are applied later.

The Illinois experiments feature the repeated stress of steel under regular repetition and are accompanied by very careful static tests, impact tests, and special magnetic tests. An endurance limit of 100,000,000 cycles or repetitions was decided upon and it has been determined that every sample which survives this strength is adequate for the most rigorous field service. To illustrate the severe wear to which the metal parts are exposed in actual service—it is worthy of note that in the case of a steam turbine rotating at a speed of 3,000 revolutions a minute, the shaft suffers a reversal of bending stress every revolution. The average life of a steel turbine blade is 10 years during which it is exposed to something like 15,000,000,000 such bending strains. Under such service, any flaw or defect is sure to show. As a result of these new experiments, henceforward, it will be possible to locate these defects in the testing laboratory before the turbine blade is made. The approximate number of repetitions of stress in the normal lifetime of the following structural and machine parts are: railroad bridge, chord members, 2,000,000; elevated railroad structure, floor beams, 40,000,000; railroad rail, locomotive wheel loads, 500,000; railroad rail, car wheel loads, 15,000,000; air-

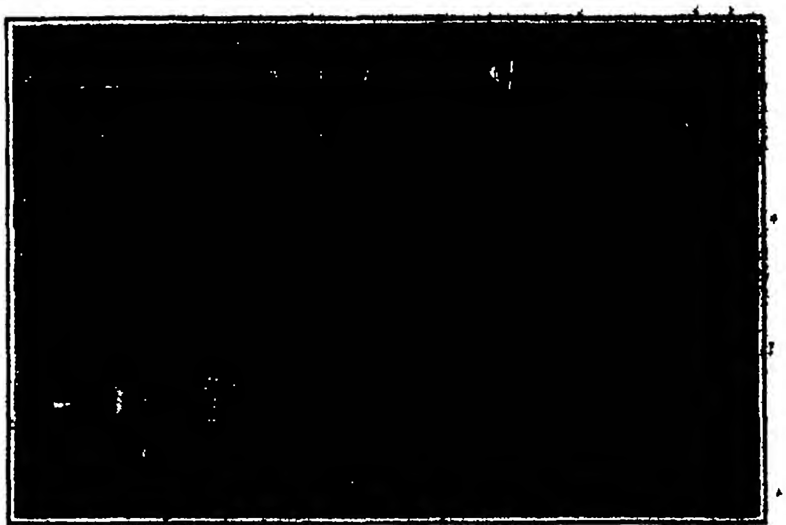


Left: Single-blow impact-testing machine. Right: Rotating-beam testing machine

Some of the apparatus that induces weary steel to tell its story

plane engine crankshaft 18 000,000 car axles 50 000 000 automobile engine crankshaft 1 000 000 000 line-shafting in shops, 300 000 000 and steam engine piston rods, connecting rods and crankshafts 1 000 000-000

Professor Moore has been working to perfect a commercial method for predicting the fatigue of different steels and irons and in this research work he is testing out all the related laboratory methods and laws From each sample of steel, he machines 20 specimens each of which is 4 inch in diameter and 13 inches long Some of the samples are first submitted to physical tests which subject the steel to stretch and deformation tests and under stretching pressure of 10 000 or 12 000 pounds or whatever amount is required stretch the steel sample out like taffy candy until it "necks down" and finally breaks The heaviest steady load test machine in use in the Illinois University laboratories has a capacity of 600 000 pounds A special electrically driven machine with a backward and forward vibration is so equipped with heavy springs that the amount of compression is recorded by a special attachment in graph form indicative of the repetition strength of the sample under vibratory strain



Machine that tests the change in physical properties with rise in temperature

A battery of 15 stress machines of the rotating beam type—really facsimiles of a freight car axle upside down—are so arranged that every rotation of each machine reverses the stress on the sample which is being tested on it The steel sample is inserted like an axle in this machine and is rotated at the rate of more than 2 000 000 revolutions a day These test conditions duplicate closely those of the ordinary railroad car or automobile axle in motion Each test is continued for 45 days when the samples will have been exposed to 100 000 000 repetitions of stress Samples that withstand this modern mechanical torture chamber successfully are qualified as endurance satisfactory for the purpose intended The arrangement is such that if the sample collapses before the completion of the test an electrical connection is broken automatically and the machine stops A special counter is used on each machine to record the number of revolutions The experiments have demonstrated the general fact that if the steel samples do not fail by the time they make 10 000 000 revolutions they will survive the strength test of 100 000 000 rotations on the machine and so far as can be predicted from the test results will survive an indefinite number of repetitions of stress

The action upon the steel in the testing machines is in the nature of a constant backward and forward bending motion," reports Professor Moore "For example a wire will bend double once without breaking but if you wiggle it back and forth a few times, it invariably will snap When a car axle stands at rest the upper portion suffers tension from the weight sustained at each end. Simultaneously the lower surface is being exposed to compression or crushing action If the axle is rotated a half turn, this condition of the wheel sections is reversed In a word the wheel is undergoing the same action as that which snapped off the wire—a much severer test than to support a single, stationary load. The microscope shows that a peculiar action occurs in the internal structure of the steel during this process After repeating stress, steel will snap almost without any warning while under a single heavy load it will crumple In the former instance the steel behaves as though it were a brittle instead of a ductile metal

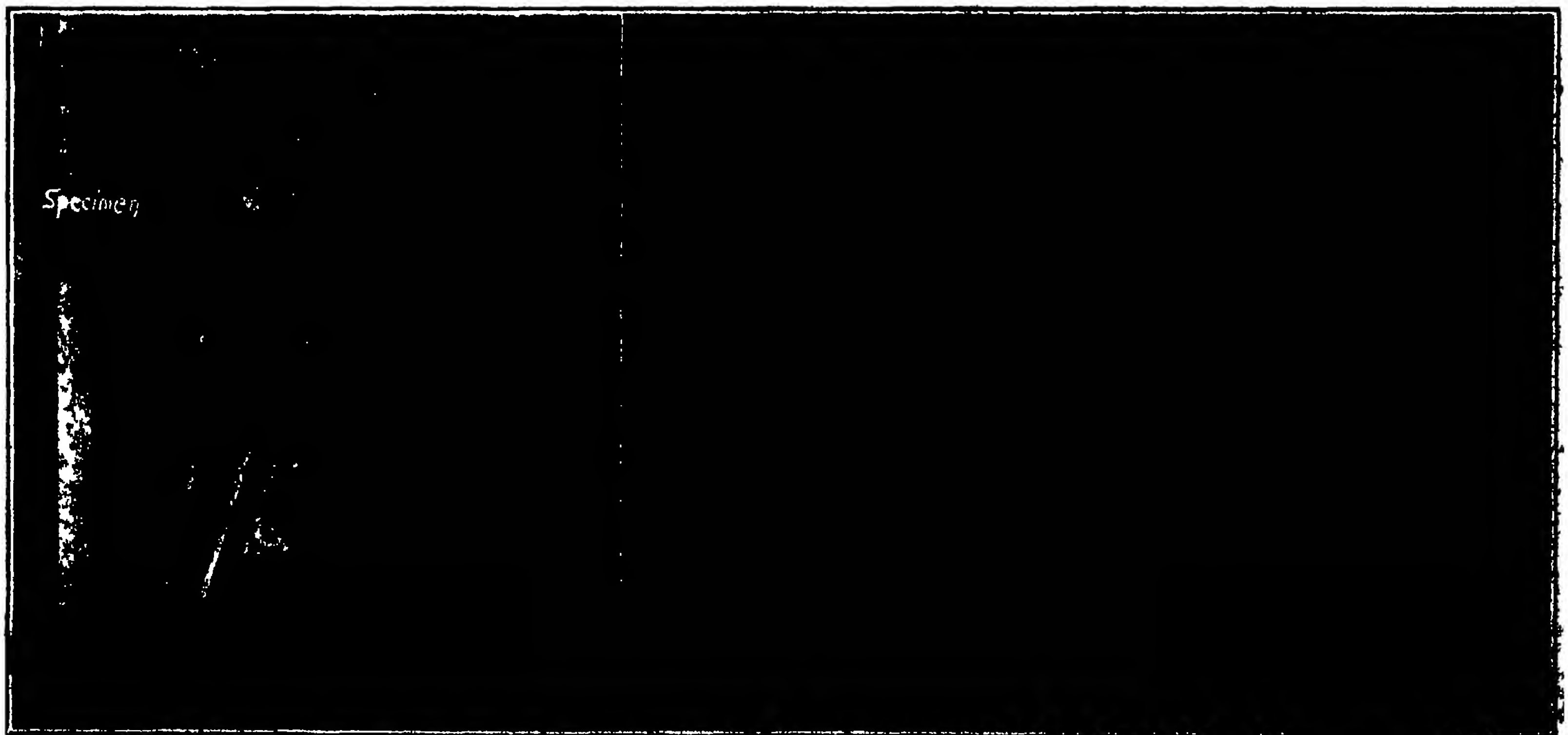
A peculiar pendulum-like hatchet is the outstanding feature of another testing machine which is used to subject the steel samples to abrupt and rapid shock and jar A small notch is cut in the steel rod which then is placed in position so that it will receive the full impact of the pendulum as it completes its swing through an arc of 160 degrees Special records are kept of the breaking strength of the steel rods in this test Another repeated impact machine is so adjusted and mounted that it hammers the test samples first on one side and then on the other Another sensitive machine is equipped with a microscopic arrangement so that it registers very slight deflections of the steel under definite pressure. However, these tests under heavy, sudden impact do not seem to give any reliable index of the ability of the steel to withstand millions of repetitions of light loads. One of the purposes of the extensive investigations under the direction of Professor Moore has been to devise a short cut, standard system of testing steel samples which is efficiently adapted for general utilization in commerce and industry.

The principles of this new test were suggested several years ago by an English engineer named [illegible], but the infallible reliability of the test and methods for its most efficient performance have been worked out at the University of Illinois. The machine for making the new test is inexpensive. It can be applied, in some cases, to machine parts which are to be used in actual service, as the test does not injure the specimen tested It may be possible to test an automobile crankshaft, an elevator wire rope, a bridge girder, a car axle or a railroad rail before these respective parts are installed

It has been found that if under repeated loading, incipient cracks begin to form, then the formation of these cracks is accompanied by a very slight rise in temperature—a small fraction of a degree. This rise of temperature occurs in a minute or two after the repetitions of stress have begun. The proposed test for "fatigue" developed at Illinois University is in effect the application of a clinical thermometer to a steel specimen to which repeated stress is applied

A vise is used which holds one end of a specimen, and an adjustable eccentric which "wobbles" the other end of the specimen by any desired amount. A micrometer is used to measure the amount of "wobble" which determines the amount of stress applied. The "clinical thermometer" used is really a delicate electric thermo-couple which is held against the specimen at the point of maximum stress In turn, it is connected to a delicate galvanometer whose readings measure the temperature developed, even though it be as minute as one one-hundredth of a degree. If the test shows no development of "temperature," the "wobble" is increased and another run made In fact this program is continued until a decided development of "temperature" is shown The stress corresponding to the "wobble" which causes this rise of temperature is the "endurance limit" for that particular steel

The "endurance limits" determined by this rapid "rise of temperature" test have been checked by comparison with the endurance limits obtained by the slow, tedious experiments on the rotating beam machines, and the correspondence of values is very satisfactory.



Left: Testing apparatus for repeated bending *Right:* The machine that subjects the test piece to repeated twisting, which is [illegible]

Putting steel through the acid test of long repeated stress of the same size

Zeppelin-Staaken giant monoplane, with the wings internally braced. This machine is still an experimental type, so that its merits remain to be proved It has out-board engines—four 260-horsepower Maybachs

The Revival of the Monoplane

Reasons Why This Type, Once Replaced by the Biplane, Has Again Become the Favorite

By Ladislas d'Orcy

SIX years ago the writer pointed out in these columns* how certain requirements of military aeronautics had, early in the war, brought about the elimination of the monoplane type of flying machine. In fact, it may be said that in a general way the war in the air was fought and won with biplanes, the few exceptions to the rule—Morane-Saulnier and Fokker monoplanes, Sopwith triplane, etc.—being hardly worth the mention.

But today we are witnessing a strong revival of the monoplane in this country as well as abroad. What are the reasons for this latest development? Is this only a passing phase, a designer's fad, one is tempted to say, or has the monoplane come back to stay? And will it in its turn supplant the biplane and the triplane?

To give an adequate reply to these questions it is first necessary to make clear a fundamental point in aerodynamics.

Junkers six-seater cabin monoplane, which afforded the first practical solution of the internally trussed, strutless monoplane. Engine: 230-horsepower B.M.W.

For the same area a monoplane wing, or single-decker, is and always will be more efficient than any combination of superimposed or following wings, because the latter mutually interfere with their progress through the air By this is meant that while in a monoplane the air stream which the wing sets up in its path escapes freely, in a biplane, for instance, two such air streams are created which constantly collide. As a result a biplane wing combination lifts only about four-fifths the weight a monoplane of the same wing area is capable of supporting.

This theory was as well known in the early days of aviation as it is today Yet about 1914 the design of tractor biplanes had made such progress that it became extremely difficult to build monoplanes of equal if not of superior efficiency This may sound peculiar in view of the greater theoretical efficiency of the monoplane wing, but the fact of the matter was, as it so often happens, that theory and practice were at considerable variance.

To begin with, a tractor biplane could be built with wings trussed on the Pratt or the Warren principle, so that the question was merely one of suitably applying the principles of bridge construction. With the monoplane the problem was not so easy to solve, for here the single wing had to be braced on the king-post principle to the center line of the machine. As the engines then available were of low horsepower, the construction [illegible] had to incorporate extreme [illegible], which limited the proportions of the fuselage to a narrow girder [illegible] not deep enough to afford [illegible] of attachment to a rigid [illegible] the wings had to be [illegible] pyramid built up [illegible] the fuselage. As a consequence [illegible] of head resistance [illegible] arrangement [illegible] which theory showed it to be endowed with, on aerodynamic principles alone.

From the military viewpoint, also, the monoplane seemed less desirable than the biplane, because the pilot was seated in the centre of the wings, where he possessed little vision downward, although his vision for ward and upward was excellent. Hence it is small wonder that the monoplane lost for many years the favors of aeronautical engineers and pilots.

Morane monoplane, typical of pre-war construction, used in training American pilots in France. Engine: 80-horsepower Anzani

But as soon as improved methods of construction were devised, chiefly as the result of the advent of more suitable materials, and more powerful engines were successfully produced, the question of the monoplane came once more to the fore Toward the end of the late war the tractor biplane had been developed to such a high degree of efficiency that improved performance could only be expected from higher horsepower or from wing sections giving greater lift Hence it is natural that aeronautical engineers should once more have turned their attention to the monoplane If this type could be built in such manner that its parasite resistance (*i. e.*, the resistance of those portions of the structure which do not contribute to sustentation) were no greater than that of a biplane, the monoplane would obviously be the more efficient of the two types, because for the same wing area its lifting power would be greater If, furthermore, the parasite resistance of the monoplane could even be reduced below that of a biplane, the former would score so much the heavier

Experiments along this line of thought came to a head in 1918 with the appearance of an American machine, the Loening fighting monoplane, a slightly modified model of which is shown below The tests of this machine were a revelation with respect to the possibilities of up-to-date monoplane design Although carrying two men with the military load of a two-seater fighter-observation airplane, the Loening monoplane showed a performance comparable with that of the best single-seater pursuit machines of its day The answer to this revelation was that in the construction of this machine the parasite resistance was reduced to a minimum, owing chiefly to the bracing system, which consisted of four streamlined steel struts The problem of visibility on the other hand, was solved by fitting the wings flush with the top of the fuselage and by letting windows in the side of the fuselage, through which the pilot could well see the ground The vision upward, of course, remained as good as it ever was in a monoplane.

A further advance in the efforts tending to make the monoplane more efficient was accomplished in the German Junkers monoplane which came out after the armistice While the Loening monoplane achieved its notable performance with orthodox systems of wing and fuselage construction (wooden framework and internal wire trusses), the Junkers machine incorporated some radical innovations. Coming to the logical conclusion that external trusses are the main source of parasite resistance, the designer of the Junkers decided to build the wings on the cantilever principle, so they would carry the flying loads as beams. At the same time he adopted duralumin to the exclusion of all other materials both for the structure [illegible] the outer skin. The framework of [illegible] Junkers monoplane is built up of duralumin tubing, while the covering consists of corrugated duralumin sheathing. As a further innovation the wings were mounted flush with the bottom of the fuselage,

Loening monoplane, which originated the modern tendency of bracing the wings with rigid struts instead of with wires. Engine: 300-horsepower Wright-Hispano

*[illegible], Sept. 4, 1915: "How the War Has Modified the Aeroplane."

which gives the Junkers such a peculiar appearance, although it does not seem to influence its flying qualities.

The performance of this machine was very remarkable for the low horsepower employed, but extended operation showed up a number of flaws which were to be anticipated in an experimental type of such unorthodox nature. Owing to the exclusive use of metal in the construction of the fuselage, the vibration of the engine was transmitted over the entire body, causing crystallization. Thus cracks developed in the covering of the fuselage. On later models this drawback appears to have been overcome by mounting the engine on ash bearers to absorb vibration.

The Junkers' monoplane embodied still another novel principle, that of utilizing the metal skin for structural strength. This principle is open to objection in that the strength of the machine may be greatly reduced if the outer skin is injured, even if this is not visible, such as in the early stages of crystallization. It is understood that the latest Junker machines are no longer built on this principle, the framework alone being now capable of withstanding the stresses developed in flying.

Another interesting solution of the internally braced monoplane is afforded by the Fokker cabin machine illustrated, which is extensively used on the European airways. In this machine the fuselage is built of welded steel tubing, which is covered with veneer in front and with fabric in the rear, while the wings are entirely built of wood, including the covering, which is of veneer. The wings are flush with the top of the fuselage, the designer being evidently of the opinion that aerial travelers prefer to look down on the ground rather than skyward—which practical experience appears to bear out. The Fokker cabin monoplane has given a very good account of itself in operation. The pilot is seated in front of the wings in an open cockpit where he has an excellent view of both ground and sky, and from where he can also keep an eye on the engine.

The three examples of modern monoplane construction we have dealt with may be said to have opened a new era in the design of airplanes. They have conclusively proven that in so far as single-engined airplanes are concerned the monoplane is not only theoretically but also practically more efficient than the biplane. While it is true that at present the wing structure of a biplane weighs less than that of a cantilever monoplane, this is merely a passing phase due to less experience in the construction of the latter.

Regarding multiple-engined machines, the situation is not quite so clear. There are some grave objections against twin-engined airplanes in which the engines are mounted outboard and efforts are now being made to solve the problem of a central engine room containing several power units, a portion of which would keep the machine in flight should one of the engines fail. When this problem is solved—as it must be sooner or later—the monoplane will probably still appear to be the most desirable type, just as it is today for use with the single-engined power plants of present practice.

An attempt worth mentioning at a multiple-engined monoplane is the Zeppelin-Staaken giant machine. In this airplane, which is built to carry twenty persons, the four engines are housed in the depth of the wings, and a passageway is fitted in the latter to enable a mechanic to adjust the engines in flight. Although this machine has made several successful flights, it is still in the experimental stage, and adequate comment is therefore impossible.

Resuming, it may be said in reply to the questions which head this article that—

(1) The revival of the monoplane is due to improved methods of construction which make it more efficient than the biplane;

(2) The monoplane is likely to become the standard type of small and medium sized flying machines up to the highest power of a single engine.

(3) Insofar as large multi-engined airplanes are concerned, the monoplane type seems chiefly restricted by considerations of encumbrance (difficulty of housing, need of large fields) so that biplane, and even triplane, construction will likely survive in the very large types.

Fokker six-seater cabin monoplane. Note the position of the wings, on a level with the top of the fuselage, so as to clear the body

Fokker six-seater cabin monoplane: another solution of the internally-braced monoplane. The engine is a 240-horsepower Siddeley "Puma"

Difference Between Molds and Wood Destroyers

NOT all fungi which live upon wood impair its strength, but conditions which promote the growth of molds, blue-stain fungus, and other non-injurious fungi are usually favorable to the growth of the wood destroyers, and these may be active on the same wood bearing the molds. Hence, the presence of mold on timbers intended for any structural purpose should cause them to be looked on with suspicion.

In the early stages of their growth the molds and the wood destroying fungi sometimes have a very similar appearance, and there is no simple means known to the Forest Products Laboratory by which lumbermen and wood users can separate them at sight. The surface growth of molds is generally cottony or fuzzy in appearance, the mycelium, or fine mold threads are interwoven, never compacted into membranous sheets or strands. The mycelia of wood destroyers may be fluffy and glistening, but more usually are compacted into strands or fan-shaped patches.

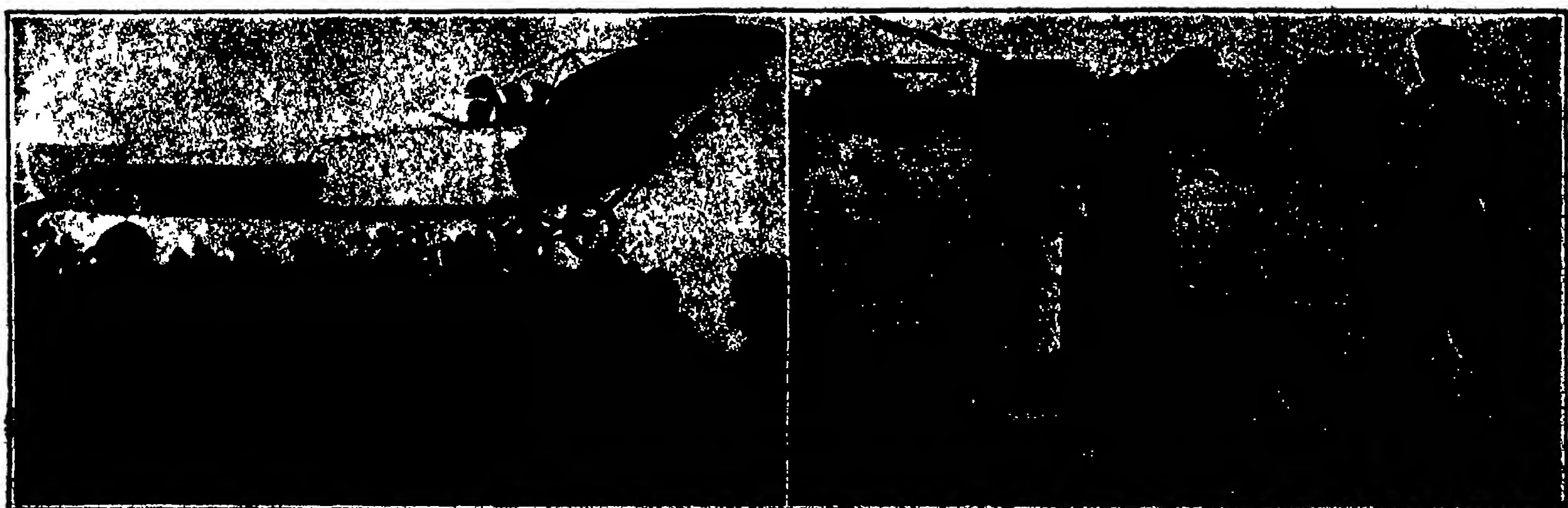
The characteristic feature of mold growth on wood is the fact that the minute threads which enter the wood do not bore into the wood fibers or dissolve them away. They pass through the spaces between the fibers or enter them through the natural openings, called pits, which are found in the walls of certain cells. Starches, sugars, and other contents of wood cells constitute the food of the molds.

The wood-destroying fungi are able to send their threads right through the wood fibers, breaking down the cell walls and utilizing portions of this decomposed material as food. This action very markedly weakens the wood, making it crumbly, stringy, or spongy, in other words, producing rot or decay. The presence of wood-destroying fungi in an advanced stage of growth is evidenced by fruiting bodies, commonly called mushrooms, toadstools, conchs, or brackets.

The principal economic loss caused by molds is through the staining or discoloration of the wood. No greater injury may be caused by the wood destroyers in their early stages, but their work will continue and finally result in the destruction of the wood if favorable moisture and temperature conditions prevail. Further details may be had from the Forest Products Laboratory, Madison, Wis.

Flying Yet Not Flying

YEAR after year new amusement devices are added to our amusement parks in order to furnish new forms of entertainment to a fickle and even jaded public. Now comes a Californian, R. R. Reed, who has hit upon the novel idea of supplying the thrills of flying without any of its dangers. He achieves his end by making use of a simple motorless monoplane which is shown in the accompanying illustrations, a system of cables and pulleys, and an electrically driven drum. The drum, it will be noted by studying the accompanying illustrations, supplies the motive power to the airplane, which rises off the ground in the same manner as a kite being pulled by a running boy. However, in order to maintain the lateral balance of the airplane, a system of cables is placed over the course of the flight to guide the pilotless machine. Upon completing its short trip the airplane, which is provided with wheeled landing-gear at front and rear, is hauled back to the starting point, and is at once ready for another "flight."



The pilotless airplane in flight and, at the other end of the cable, the electrically-driven drum which supplies the motive power

The Mechanism of the Pipe Organ

What Happens When the Player Passes His Fingers Over the Keys

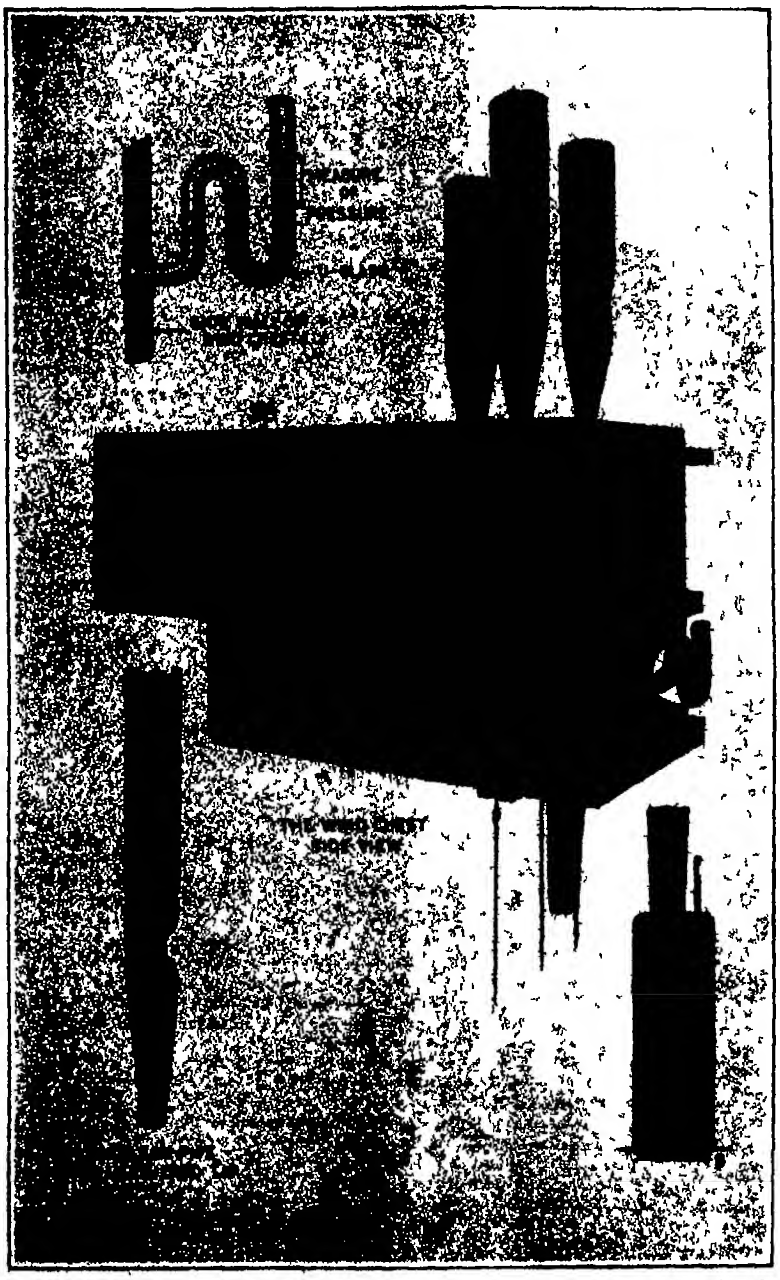
By J. F. Springer

WHILE people in general are familiar with the appearance of the keyboards, stops and exterior pipes of the pipe organ, few have anything but a very vague idea of the means by which the pressure of the finger on a key operates to send a jet of compressed air into one or more speaking pipes. The combination of mechanical and other elements leading to this end is the *action*. Pipe organs are controlled by different styles of action. But all have *wind-chests*. These are boxes, filled with compressed air, and placed beneath the bottom openings of the group of pipes served. Each of the openings into the individual pipes above is closed by means of a kind of hinged valve called a *pallet*, and into groups of pipes by sliding valves called *sliders*. To cause a pipe to speak, it is only necessary to open the proper slider and the proper pallet. Ordinarily there are as many wind-chests as there are subsidiary organs in the instrument. Thus, the great organ or the swell organ will consist of an aggregate of pipes served by its own special wind-chest. There are some big organs in England, and perhaps others elsewhere, which provide more than one wind-chest for a single subsidiary organ. In the Town Hall at Leeds, England, the pipes of the great organ are divided into two aggregates, each of which has its special wind-chest.

The several subsidiary organs are subdivided into groups of pipes called *stops*. Each stop ordinarily consists of a series of pipes belonging to a continuous portion of the chromatic succession of musical notes and all having some especial tonal quality in common. Thus, a flute stop will consist of a series of organ pipes corresponding to all the notes in some range of pitch and all having a flute-like tone. To play a subsidiary organ, one first draws the desired stop-knobs or stop-handles, which in consequence draw the sliders of the corresponding stops. No sound issues as yet, because the pallets still block the way of the compressed air. The keys of the proper manual or pedal board are now depressed severally or in chordal groups with the result that the corresponding pallets are opened and the compressed air allowed to rush into the corresponding pipes. The organ now speaks in single notes or in chords.

A little thought will prepare one to understand that it is quite important how and when the pallets respond when the keys are depressed. It is highly desirable that nothing akin to a "hang fire" response occur. In modern organs, the console is often at a very considerable distance from many of the pipes. The keys may, accordingly, be near some and distant from others. There should be no difference in the response of the corresponding pallets. It would be intolerable to strike chords on two manual boards and one pedal board simultaneously, only to hear from the three different organs at three different instants. It will perhaps be gathered from these remarks that the action is a vital feature, because it is the very thing depended upon to connect the movements of key and pallet.

A representative wind-chest is shown in side section in the group of drawings on this page, and again, at the lower right, in front section. The box A is the wind-chest. The compressed-air supply may be introduced through the side or bottom. In the present case, it is supplied through the windtrunk B entering at one side. The sliding piece F is the slider for one stop. It must first be drawn to admit air to these pipes. Admission is further controlled by the pallets G. Springs beneath these pallets hold them up against the exits from the wind-chest. Several of these springs are plainly in view in the side view, holding their pallets in closed position. Wires, known as *pull-downs*, are attached to individual pallets and are passed vertically down through small holes in the bottom of the wind-chest. Upon one of these wires being pulled down, the pallet will be opened and the compressed air allowed to rush in through D to the foot of the organ tube above. The mode of attachment of the pull-downs to the pallets is by means of loops of wire secured on the under sides of these valves. The sliders are long strips of wood pierced at intervals with holes. When the stop-knob is pulled out, the slider shifts so as to bring these holes



Center: A typical wind-chest, seen in side view. *Lower right:* The same wind-chest seen from in front. *Upper left:* The double-U tube for registering the compressed-air pressure in the wind-chest. *Lower left:* Open diapason pipe, showing the leathered lip

Drawings of modern organ parts, showing where the wind comes from and where it goes

underneath the individual pipes of the stop, and when the stop knob is pushed back, the unperforated spaces between holes close the air conduits. Naturally, there is no great difficulty in providing the necessary mechanism for shifting the sliders back and forth, except perhaps where the distance between stop and stop-knob is considerable. But the case of the pallet is far different. In the older system, the connection between key and pallet was made by means of a series of links and levers. The series was called the *tracker action*. The pallet eye and the pull-down were at one end of this.

In one of the views is shown a model exhibiting in section the entire mechanism, including the rocker action, from manual key to speaking pipe. Two white keys are in view, the one in front being depressed. As it is down, so also should the pallet be down. This may be seen to be the case by looking further to the right and further up. A transverse section of the wind-chest is seen, together with the depressed pallet and the spring underneath it. Two sliders may be seen, in section. Apparently, the wind conduit near the one is cut off by one slider, that near the other is open, the hole through the slider being in line with the parts of the air conduit above and below. Consequently, with this conduit open all the way at the same time that the pallet is depressed, compressed air from the wind-chest will rush in above the pallet and up through the open conduit into the foot of the pipe immediately above. The key being down, the vertical arm at its right hand end is up. Consequently, the right angled lever on the left has been slightly shifted clockwise on its pivot. There is, to the right, a second right angled lever. The lower arms of both levers are connected by a horizontal rod or link. The effect of the clockwise shift of the left-hand lever was to shift clockwise the right hand lever. The upper arm of the second lever was consequently depressed and a drawing-down of the links above effected. That is, the depression of the key produced a downward pull on the pull-down and a depression of the pallet.

Ordinarily, there are about six joints in a rocker section and these were naturally sources of friction. In order to restore conditions when the finger of the player was lifted, the spring under the pallet had to be strong enough to overcome quite a number of weights and sources of friction. Indeed, there would frequently be another complication, involving additional friction. This was a device known as the *roller board*. Its function was to transmit sideways the pull designed to depress the pallet. This needs explanation. Frequently, keys close together control speaking pipes of considerable size. If heavy pipes were all to be put in the same vertical plane with the key, then for the case where a series of keys controlled a lot of big pipes of the same stop or subsidiary organ, the wind-chest might be excessively weighted at one end. As this was undesirable, the roller board was introduced in order to provide for a better distribution of the weight along the length of the wind-chest. Further, big organ pipes consume an immense amount of air. To provide adequately for its introduction to the foot of the pipe, the corresponding pallet was given a larger area. It will now be understood, perhaps, that with this greater size of pallet conjoined with the action of the roller board, the spring underneath the pallet had to be a good strong fellow in order to restore normal conditions of the whole action. This spring, however, had to be overcome by the organist in order to produce the sound. We have here an explanation of the difficulty of playing many lower notes on older organs. In fact, the old system involved still other sources of difficulty, particularly the resistance of the wind pressure which was added to as the number of stops in use was increased. When the organ was a large one with many stops, and the keyboards were coupled together, it required considerable exertion to bring out the full power of the instrument, sometimes the organist had to stand on the pedals and throw the weight of his body on the keys to get a big chord. Various schemes were tried to better matters. The most successful appears to have been a division of the pallet into two parts. A reduced quantity of wind was introduced and this relieved the pressure underneath

before the pallet was completely depressed But the results now possible with modern organs were out of the question

An improvement was made in England It consisted principally of a little bellows about nine inches long which was given a duty in connection with the action The organ wind itself would be admitted to this bellows by the effort of the player against a small valve The wind rushing in and expanding the bellows the mechanical movement of the top of the bellows was utilized to depress the pallet C S Barker the inventor proved to be a prophet without honor in his own country and went away to France where the practicability of the new idea was established After this, his own people woke up and the *pneumatic lever* became in time a thoroughly recognized feature in successful organ building Modern organs of the most up-to date character are understood to use actions whose development was founded upon this invention which dates back from about 1832

In the old days before Barker and his progressive contemporaries and successors had met with full success in introducing their ideas an ordinary key when coupled required a pressure of 20 ounces to depress it It was not uncommon to find bass keys requiring a pressure of 50 ounces or more There is in New York City an organ having bass keys requiring a pressure of 40 ounces But the modern organ is built so that a pressure of 3 to 4 ounces is the standard effort required The pneumatic action as developed by Willis Cavillé-Coll and many others is for short distances between key and pipe a fine device and is said by competent authority to be prompt both in attack and in repetition

Apparently the first installation of the *tubular pneumatic* action was made in the construction of the big English organ in St Paul's Cathedral London The organ was divided into two parts and the keyboards located in the one half Under the old system this would have required running trackers down to and underneath the floor (30 feet below) and up again The builder however used tubes instead and thus arranged that an impulse of air should pass through and accomplish the desired result with the aid of pneumatic levers This action has been praised and condemned It is much in use, in a modern form and is doubtless successful under favorable circumstances. A long distance from key to pipe is apt to prove a large difficulty in the way of its satisfactory use Pneumatic impulses travel slowly—at a speed which does not reach 1100 feet per second And yet it became desirable to locate the organ at points far from the player As late as 1890 in response to a desire for such arrangements as would permit the organist to be very close to the cathedral choir a big English concern stated that 'Dame Nature stood in the way

Today, however, organs are built and distributed all over. The console is even movable from point to point The instantaneous action and incredible velocity of the electric current make it an ideal agent for the transmission of the impulse of the organist's fingers to widely scattered pipes. The first attempts seem to have been, for the most part, failures, but the fundamental idea was so attractive that builders and inventors persevered. The original invention has been ascribed to Barker, already mentioned, and to Dr Péschard. The early experiences resulted in a poor reputation for electric actions. The revival of interest later on was, it seems, to be ascribed to Mr Robert Hope-Jones. He was a skilled electrician, but was unacquainted with the efforts that had already been made. He constructed the first movable console. This was apparently about 1886. He created an electric action that roused the organ world

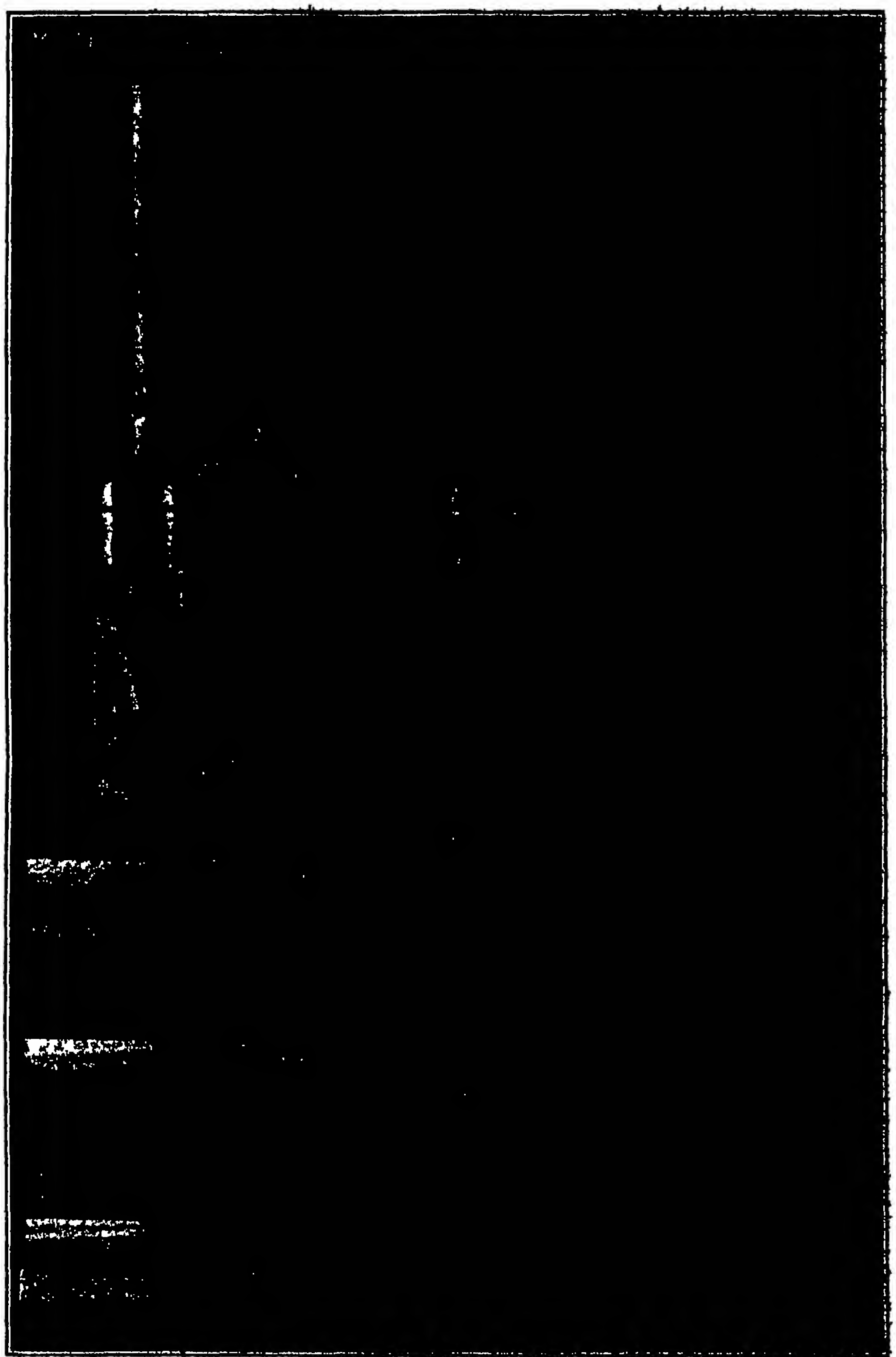
Naturally, the matter has been developed during the past years In one of the views of sectional models is shown an electro-pneumatic action. The organ tube is at the top. The wind-chest is below. The pallet which admits and shuts off air is seen at top of the interior of the wind-chest. Beneath the latter is the magnet box. Through these, the electric current which is caused to flow by depressing the key operates one or more valves controlling the air supply. A small bellows-motor is seen in the wind-chest, whose duty it is to move the pallet.

The perfected tubular pneumatic and pneumatic-electric organs are often divided into parts. In this way, organs have been successfully installed in buildings which could not have received a big organ en bloc.

An important feature in many modern organs is the *stop-key* This is a substitute for the stop-knob or stop-handle. Some organs have stop-keys only; others have them as part of the equipment for the control of stops and couplers. The stop-key may assume the form of an ivory tablet. It is only necessary for the organist to touch it to get the service desired. With a row of them, the finger simply passed along suffices to put great masses of pipes into and out of action.

A second great advance in organ development has to do with the modifications of tone that may be brought about by suitable means. Tone has to do with the quality of sound and is concerned not at all with its fundamental pitch It is a discovery of the nineteenth century that the difference in quality of musical notes from different instruments is due to the number, relative strength and distribution of certain subsidiary sounds sometimes termed overtones. If there are no overtones, the sound is pure. Perhaps the best example is the note produced by the tuning fork Most musical sounds are, however composite—that is they consist first of a dominating pure sound whose pitch is reckoned as the pitch of the whole and, second, of an assortment of weaker sounds of higher pitch. If these overtones are very well confined to pure tones having such pitches as to produce a proper musical chord, then the total effect is pleasing and we say that it is a musical sound. But, if there are overtones such that the total combination contains prominent pure tones falling outside of a proper chord, we have a noise. There is doubtless a borderland where the harsh effect is mild and subdued and is not unpleasing to the ear

If the sounds issuing from a pipe organ were confined to pure tones, the general effect would be quite insipid. The simplicity would be [illegible] and a tendency would [illegible] come [illegible] to play the higher in the regions of high pitch, in order to [illegible] of the [illegible] [illegible] that would [illegible] the [illegible]. That [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] the C which [illegible] [illegible] [illegible] [illegible] the C [illegible] [illegible] [illegible] [illegible] [illegible]



The rocker action, formerly the standard compared with the tubular action and with the latest style of electrical action

How the operation of the keys is communicated to wind-chest and pipes

[illegible] come rather soon when he will hear [illegible] but also G. Other notes may be detected by [illegible] the experiment. Technically, the fundamental [illegible] tone of a musical note and the weaker [illegible] of higher pitch are termed the *partial* [illegible].

Now it was found out long ago that, while the effective length of a tube is a principal factor determining the fundamental tone of the note uttered by it, this was not the only factor. Thus, with the tube used in [illegible] and known as the French horn, various fundamental tones may be produced by tightening the lips and increasing the pressure on the air jet issuing from the mouth. Thus, C two octaves below middle C, C one octave below, middle C itself, and C one octave higher, may all be produced without changing the tube length—as by finger holes or valves. In fact, the G just below middle C and also the first and second octaves above this G may be got without introducing any change of length. Next, we may get E above middle C and its octave above. Finally, we may also get D, F and A of the octave above that beginning with middle C. Upon realizing the foregoing, one is prepared to understand that wind pressure plays its part, and that higher notes may be developed by increasing it.

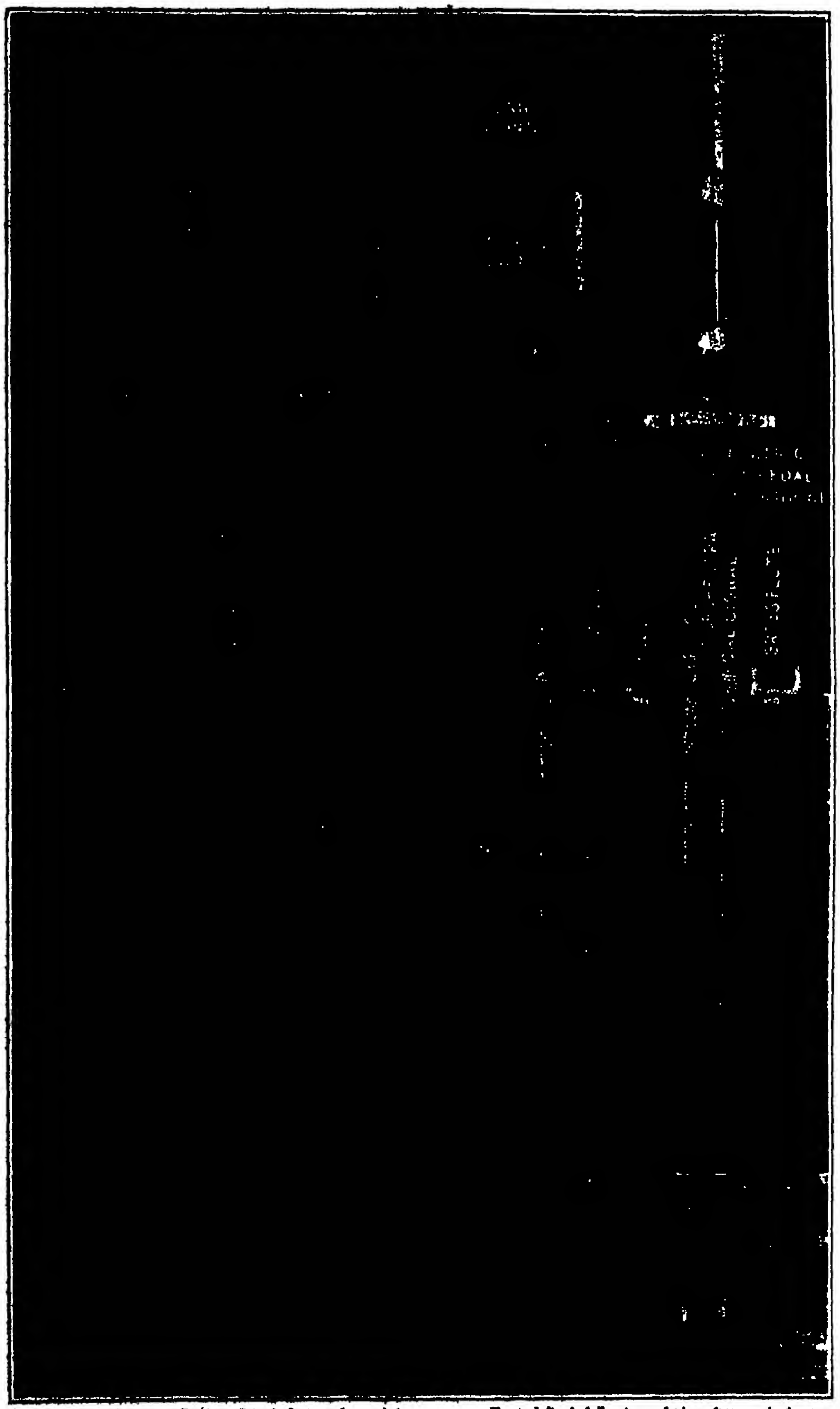
The old organs seem to have been voiced upon very moderate wind pressures—say, from ½ ounce to 1¾ ounces per square inch. The pressures are usually stated in terms of the inches of height required by a head of water to produce an equal pressure. From this point of view, it may be said that the old organs were generally voiced in the range 1½ to 3 inches. This custom arose, apparently, from the use of the wind-gage invented about 1677 by Christian Förner. It consists of a glass tube having a double-U shape. A little water is put into the tube and then one end is inserted, along with a socket, into a hole in the wind-chest. The air pressure may, if the tube is covered properly, be made to hold the water in the more distant U so that it will disclose different levels in the two vertical arms: see the first group of drawings. The difference in level is manifestly the head of water restraining, and therefore equal in pressure to, the compressed air. Modern organ pipes are voiced at pressures running up to 10, 20 and 30 inches. In large organs, there may be different pressures for different wind-chests. As the pitch of the fundamental—or first partial, as it is called—may be varied by changes of wind pressure, it is not so difficult to grant that quality may be [illegible] by variations in [illegible]. The modern advance [illegible] in respect to tone [illegible] depended in part upon the increased pressures [illegible].

[illegible] quality is affected also by the material and by the [illegible] of the tube. There are still several other factors which contribute to this.

Even in the older days, the material and shape were understood to influence quality. And it was also understood that an open pipe gave a different quality of tone than a stopped one. The difference with us, as respects this last point, is that we have some comprehension of why this is the case. We now know that the upper partials are different. Thus, the pitches of the series of partials, beginning with the first, for an open pipe may be represented by the series of numbers 1, 2, 3, 4, etc., while those for a closed pipe, by the series of numbers 1, 3, 5, 7, etc. That is, these numbers show the relative numbers of vibrations. With the open pipe, we get the successive octaves of the fundamental, which naturally tend to strengthen that sound. One should bear in mind in this connection, that the octave next above is always got by multiplying by 2. If one writes out the two series at some length, he will have opportunity to see that the first consists of the second plus octaves of the second. But these octave echoes of the second are doubtless in general rather faint, so that a better comparison is simply to view the first few partials of each as substantially the whole. Thus if we regard 1, 2, 3, 4 as all that correspond to the open pipe, and 1, 3, 5, 7 as all that correspond to the closed pipe, we are ready to see that the open pipe gives a simpler sound, since 3 is the only number not an octave of the fundamental. With the numbers of the closed pipe, we have four different numbers, no one of which is an octave reproduction of the other. The open pipe, thus analyzed, is perceived to utter a purer and simpler tone. The closed pipe, by adding marked differences, gives forth a more brilliant sound.

There is a method of getting a kind of subsidiary partial. If two musical tones of different pitch are sounded together loudly and continuously, secondary tones will be heard. In particular, if two organ pipes having an interval of a fifth, one of them CCC (3 octaves below middle C) and the other GG (between CC and CCC), are sounded together, there will be sounded a note that is an octave below the lower one. This is CCCC. Thus by using a pipe 16 feet long in conjunction with another 10 2/3 feet long, an effect is got that ordinarily requires a similar pipe of 32 feet in length. In this way is got the series of notes indicated by the label on the stop-knob as *32 feet resultant*. Another method of getting a low tone by similar means is to sound simultaneously two pipes a major third apart. Two octaves below the lower one of the two will sound. This may, perhaps, never have been utilized as a means of providing a special series of notes by simply drawing a stop-knob, but the organist himself is privileged to make use of it. He may thus produce lower sounds than the organ is supposed to be capable of by playing two pedal notes simultaneously.

The *open diapason* stop of the great organ is the series of pipes in an organ which may be regarded as the foundation of the whole musical capacity of the entire instrument. These are ordinarily simple open pipes of wood with a suitable foot. About 1862 an advance made by a builder named Schulze was brought into prominence. He gave the mouths of the pipes a much greater width and provided for a freer blowing. The result was an increase in



Below: A miscellaneous collection of typical stops from various sources. *Upper left:* A full octave of pipes from a single organ. *Upper right:* Further details of characteristic stops

Typical stops of various sorts from modern organs

power and also in brilliance. Apparently, however, this treatment yielded a hardness of tone and lost the singing quality of the older open diapasons. About a quarter of a century later, Hope-Jones narrowed the mouth, inverted the languid, and thickened the metal wall. The lips were covered with leather. It is claimed that this method enables strong pressures (up to 30 inches) to be used, without the unwanted hardness of tone. The general result is understood to be substantially the old open diapason but with greater power. The leather lip, as applied to organ pipes, has become very popular indeed, both in England and America. One of our drawings shows a Hope-Jones open diapason pipe with its inverted languid, leather lip and clothed flue.

Mixture stops are apparently becoming obsolete. A number of ranks of pipes were combined with the idea of adding upper partials to old diapasons poor in overtones. The mixture stops have become unpopular probably not so much because the theory was wrong in general principle, but because the upper partials are comparatively too powerful.

The *Flute* stop is an important part of any organ. The modern development of these pipes is largely centered upon stops having the family name of *Tibia*. One form of this style of pipe is made of wood and on a large scale. The mouth is placed on the narrow side of the pipe. The block is lowered somewhat and the thick lip is covered with a thin strip of leather. The wind pressure may be anything from 4 inches up. There are whole groups of modern stops known as varieties of tibia. Thus, there are the *tibia mollis*, *tibia minor*, *tibia dura*, etc.

Among these modern stops which belong to the general advance are certain ones which imitate stringed instruments. William Thyme is the great modern pioneer. In 1896, his string stops were brought to public attention by the exhibition held that year in Liverpool. He has been followed by Hope-Jones and other progressive designers of organs.

The use of the reed in a pipe is a very ancient matter, dating back at least to the times of the old Egyptians. The shepherds pipe found in the Tyrol today consists of a tube with a reed or strip of cane in the mouthpiece. The clarinet, however, is to be regarded as the immediate parent of the reed pipe used in the modern organ. There have been reed pipes in organs for many years, but it was not until 50 or 60 years ago that the great English organ builder, Henry Willis, began to develop them. That the tone quality of the old pipe was poor is thought to be witnessed to by the old instruction books for students of the pipe organ. These books stated that the reed pipes should never be brought into use by themselves; but that a stopped diapason or other group of flue pipes should be employed along with the reeds. Willis changed all this. His reeds were, some of them at least, characterized by beauty of tone. Flue simple pipes of the open or stopped varieties were not needed in conjunction. Even in the matter of power, he raised the wind pressure and got it from the reed pipes alone. Willis seems to have been the first to prove that roughness and rattling could be entirely removed simply by giving the reed tongue precisely the right curve. He prevented some of the big reed tongues from making vibrations in too emphatic a manner by securing to them weights of brass.

The use of double-length tubes for treble notes made possible great brilliancy and power.

Hope-Jones distinguished himself in the department of reed pipes, as elsewhere, but he does not seem to have been a pioneer. He added to the results attained by Willis and others. Thus, he has improved the Willis chorus reed pipes by doubling the pressure, adding to the loading, and thickening the tongue. His double English horn and oboe horn are examples of stops of perfected beauty and power.

The Oil and Albumen Content of Seeds

A Study of the Conditions Under Which the Seeds of Oil-Bearing and Textile-Producing Plants Give Their Highest Yields

THE importance of obtaining the greatest yield of oil and fat as well as textile fiber and albuminous matter from the various oil and textile plants is evident, and during the war the necessity for maximum yield was accentuated very strongly in Germany. For this reason a very detailed study of the conditions under which the plants gave the maximum yields was undertaken. The results of the experiments are described by Dr. Kieberger in an address of which this article gives an abstract.

The plants studied were the rapeseed plant, the poppy plant, the flax plant, the hemp plant, and the dodder or oil seed plant. The literature was investigated and was found to be very scanty on the subject. Investigations were made by some experimenters on the conditions of the formation of oil and fat in the seeds of various oil-bearing plants, but nothing was done in a constructive way to determine when the formation of the oil and fat was at a maximum.

In the present investigations the seeds were tested in three stages of development, as follows:

1. In the state of green ripeness, that is, in the condition where the green seed was completely developed without there being any visible signs of the ripening of the seed having started.

2. In the state of yellow ripeness, that is, in the condition where the seed shows its full growth and manifests visible signs of the beginning of the ripening process. (The color is not necessarily yellow, it may be light brown.)

3. In the state of full ripeness, that is, in the condition where the entire plant has reached a stage of complete cessation of growth and where the seeds show their normal ripe color.

In all the seeds that were investigated, it was found that the total content of the seed in nitrogenous substances was at a maximum always in the stage of green ripeness. Similarly, the content in amides and albuminous-like substances was a maximum under this condition. In the same state of green ripeness, the content of the seed in true albumens was at a minimum.

The true albumens vary between about 15 to about 20 per cent of the total nitrogenous substances in the seed at this stage of ripeness. When the seed reached the condition of yellow ripeness, then the amides had decreased considerably, and likewise the content in total nitrogen had been reduced to a considerable extent. On the other hand, the true albumens showed a decided increase, but this increase was nevertheless smaller than the decrease in the amide content. This is why it appears that the nitrogen content, that is the content of the seed in gross protein matter, is considerably reduced when the seed reaches the state of yellow ripeness. One exception to the rule must be mentioned at this point, namely, in the case of the hemp plant. In this plant it was found that at the condition of yellow ripeness the amide content of the seed had been reduced very considerably in contrast with the true albumens, so that about 45 per cent of the albuminous materials in the seed were present as true albumens.

When the plant has ripened completely, then the situation changes radically. Due to the fact that the seed has gained very materially in non-nitrogenous substances, the percentage of the nitrogenous constituents has decreased very greatly, and the amides have been reduced likewise to a still greater degree. On the other hand, the true albumens have increased very greatly, so that at this point they amount to more than 50 per cent of the total nitrogenous substances present in the seed. Here again in the case of the hemp plant, a notable exception is to be mentioned in that there is scarcely any increase in true albumen content to be noted at the stage of complete ripeness, compared with the proportion in the seed at the stage of yellow ripeness.

In all the seeds in the green ripe condition the amount of fatty substances present was extremely small. The seed in that condition appears to be made up of layers of waxy and resinous substances which cover the seed coat and protect it from external influences. The percentage of true fats of the total fatty matter in the seed is also very small. An important change takes place by the time the seed has reached the state of yellow ripeness. The increase in the total fat content has been so large that in the case of the poppy seed, flax plant, and dodder seed this percentage of fat is almost two-thirds of what it is in the condition of complete ripeness of the plant. However, the quantity of resins and waxes is still comparatively large and it still has a very considerable influence on the quantity of true fats present in the seed.

It is only when the seed has reached the stage of full ripeness that in reality we obtain a true idea of what the oil seed contains. Now the resins and waxes have been reduced considerably and the fatty substances in the seed amount to about 30 to 45 per cent of the total dry weight of the same.

We again have an exception to the rule in the case of the hemp plant. Here it appears as if the greatest part of the true fatty content of the seed had been developed at the time the seed was yellow ripe, and the increase in the total fat content as well as the increase in the proportion of true fats is only very slight from the yellow ripe stage to the condition of full ripeness. The following conclusions are drawn:

1. The maximum content of nitrogenous substances in the seed occurs in the green ripe stage. It is decreased in the yellow ripe and full ripe state.

2. In the yellow ripe condition, the nitrogen content is constituted overwhelmingly of non-albuminous materials, amides, etc.; in the full ripe stage true albumens predominate.

3. The fatty content in the seeds which were examined in this investigation, in the green ripe condition was very slight, the far greater part of the non-nitrogenous substances being made up of non-fats, resinous and waxy compounds. When the plant has reached the condition of yellow ripeness, then the content in fatty substances has been increased materially, and particularly the proportion of true fats has grown considerably. In the state of complete ripeness it has reached its greatest development, and the proportion of resins and waxes in the seed has been correspondingly reduced to a minimum.

An explanation of these phenomena is found with ease in the science of plant physiology. This science teaches us that when the plant is young there is found in it a preponderance of substances which are of nutritious value and which are required by the plant to build up new cells and grow. These substances are then present in their maximum degree and contain largely nitrogen in their composition. As the plant grows older, that is, as it ripens, these nitrogenous substances are no longer required by the plant for its growth and are then stored up as true albumens in the seeds.

In the same manner the science of plant physiology teaches us that the fatty substances in the plant are stored in the seed in the maximum degree when the plant has reached its maturity. The explanation of the one exception in the case of the hemp plant cannot be given at this time, but requires further study.

A question of very great industrial and agricultural importance is what happens to the albumen and fat content of the seeds when they are reaped in various stages of ripeness and then stored in the granary. To answer this question we reaped the seeds in various degrees of ripeness and stored them in the granary for eight weeks until they were thoroughly dry.

It was found that the seeds reaped in the green condition shrunk very considerably, so that their outer surface was completely shriveled. Their total nitrogen content was almost the same as that of the seeds in the yellow ripe condition, but the proportion of true albumen was much less than in the seeds that were reaped in the stage of yellow ripeness. There was less shrinkage in the latter seeds and their nitrogen content was just about normal, nevertheless, the percentage of true albumens present was considerably less than that in the seeds that were reaped in the condition of full ripeness.

In the latter sort of seeds no change appeared to take place except a considerable loss of water. As far as the content of fatty substances is concerned, the seeds reaped in the green stage, after they had been stored for two months, still contained an extremely small percentage of fats and oils, there having been almost no increase in the fat content at all during the period of storage. On the other hand, in the case of the seeds which were harvested in the yellow ripe condition, the storage appeared to effect an increase in the fat content of the same. This increase was rather appreciable. The proportion of true fats was much greater, but the total fats in the seeds were still less than that in the seeds which were reaped when they were absolutely ripe. In the case of these seeds, storage did not have any effect whatever on the fat content.

In the case of the hemp seeds the above phenomena appeared to be accentuated the least, while in the case of the flax seed they were accentuated the most. The German technologists and agriculturists have decided from the results, which we have described above, that all oil seeds are much more valuable, yield a greater amount of more valuable oil and give oil-cakes which are richer in albumens, the more nearly ripe the seeds are when they are harvested.

Engineering in Truck Tire Building

Designs Which Decrease Wear, Prevent Slipping and Increase the Economy of Truck Operation

By H. W. Slauson, M.E.

TIRES are more than mere bands or tubes of rubber surrounding the wheels of a motor vehicle Real engineering design, manufacturing science and chemical laboratory work must enter into their production in order to meet the severe requirements of present day trucking. Truck tires must not only sustain the weight of an overloaded vehicle but must absorb the jolts and jars of rough road travel, must retain a firm grip on wet, slippery or soft highways and, in the case of the rear wheels, must transmit the entire power developed by the engine (exclusive of the slight frictional losses in transmission, bearings and the like) whether it be ten or fifty horse power.

To meet these severe conditions of transportation, tire manufacturers have designed three principal types of truck tires. The newest is the pneumatic tire which has developed from the type used on passenger cars. The advantage of the cord fabric used in the con struction of cord passenger car tires has made possible the design of practical pneumatic truck tires up to seven and eight inches in cross-sectional diameter and has resulted in the experimental use of sizes as large as ten and twelve inches.

The carcass of these tires is practically the same as those used on the larger passenger cars, except that, as the diameter is increased, additional plies of cord fabric are used to enable the tire to withstand the high pressures to which the casing is subjected when a heavily-loaded truck strikes an obstruction in the road. The eight-inch pneumatic tire, which is the normal size for a 2½ to 3-ton truck, should carry 110 pounds per square inch of normal inflation pressure and this will represent the normal strain to which all parts of the carcass are subjected when the truck is stationary and whether it be loaded or empty When travelling, however, the hammer blows struck by the rear wheels as the vehicle passes over depressions or obstructions in the road increases this pressure greatly until it may reach four or five times its normal amount momentarily The compressibility and elasticity of air enables the tire to absorb such jars without great danger of sudden blow-out. Therefore, it is a matter of wonder, not that the pneumatic tire when used in severe truck service does not give greater mileage, but that it can average from five to seven thousand miles each, with the necessity for a removal but once during that period for repair or replacement.

If we consider the larger sizes of truck pneumatics—those which must carry inflation pressures of 140 pounds per square inch—we find an interesting situation. Regardless of the load on the tire, the pressure for each square inch of surface of road contact will be 140 pounds,—a pressure which may well serve to rut soft asphalt surfaces. The pulling power of the pneumatic in snow or mud is great, due to the rounded contour of the tread which brings additional surface of the side wall into play as the tire sinks deeper in the mud. Nevertheless the average pressure of the tire will be 140 pounds per square inch. This will prevail whether the truck be loaded or empty, as already stated. As load is added, the pressure, fortunately, does not increase above this maximum, but the tire is flattened so that a larger surface (each square inch of it carrying 140 pounds of pressure) is presented to the road. This is a feature of pneumatic truck tire operation overlooked by many county authorities and highway commissioners in their short-sighted attempts to limit truck loads to an inefficient and absurd maximum. Such highway engineers would not be tempted to permit the use of pneumatic-tired trucks in preference to those of solid or cushion tire if they realised that the pressure per square inch of road contact of the pneumatic tired truck is the same, regardless of the load carried, and is based entirely on the necessary inflation pressure. If this inflation pressure is reduced below the recommended amount, the tire will become unduly flattened, which will cause bending of the side walls and a rapid separation of the various layers of fabric and rubber of which the carcass is composed. Nothing injures a tire more seriously than its operation when insufficiently inflated.

One of the principal objections to the use of the pneumatic tire on moderate-sized trucks is the cost. It may enable perishable loads to be carried at fairly high speeds, but the cost per mile for the two rear tires alone of a three-ton truck is nearly $ 02½ based on the not-usually-obtained distance of 10,000 miles and making no allowance for the cost of repairs for blow-outs, punctures or retreading.

The solid tire is a tire which has been used almost ex clusively on trucks up to a few years ago. It is reliable in that its mileage can be predicted with comparative accuracy It is a considerably cheaper tire than the pneumatic and the mileage which it delivers is somewhat more. Excessive wear does occur in the solid tire, however, and the cause represents one of the most serious features of tire construction with which the designer has to contend.

Rubber cannot be compressed but it is sufficiently elastic so that it may be made to flow or be replaced When we pump air into a pneumatic tire, we compress that air because we force a larger amount into the same restricted space This cannot be done with rubber If we place a pencil with a soft eraser upright on the desk and push downward on the rubber end, the eraser will be made to bulge out on the side. The rubber is not compressed but it is replaced What it has lost in length has been compensated for by its increase in width, represented by this bulge

When a rubber tire is subjected to load on the truck it becomes flattened at its point of contact with the road The rubber thus displaced must go somewhere and it "oozes out" in the form of a bulge at the front and rear of the flat portion. This bulge follows in front of the tire as it rolls along the pavement and forms what is known as the "traction wave" As the traction wave rolls round it continually stretches various sections of the tire, for there is no place into which the bulge may flow Thus, smooth solid tires will be worn down even though the truck be operated only over hard, well-paved streets.

The fact that the rubber of the solid tire has no place to which it may flow when subjected to pressure greatly reduces the resiliency of this tire and makes it hard riding and unable to absorb the inequalities in a road surface, with the result that the truck is badly racked and damaged through the undue vibration communicated to it

Thus the principal advantages of the solid tire are its longer life than the pneumatic, its reliability so far as freedom from blow-outs or punctures is concerned, and its low initial cost.

In order to overcome the objections to the solid tire and to provide something with a certainty of mileage, reliability, longer life, low initial cost and ability to secure traction, engineers have designed the cushion or semi-solid type of tire. This type of tire depends for its action on the theory which we have already stated—that rubber is not compressible, it is merely replaceable. As we have seen that the traction wave represents the greatest element of destruction in the operation of a solid tire it will be realized that the use of properly-placed displacement notches may serve to overcome this difficulty In the case of several typical tires of this make, these notches are placed on each side and extend well in toward the center They are not placed opposite each other, but are staggered, with the result that each section of rubber thus formed is bounded by a notch of ample width into which the rubber may "flow" when that section of the tire is subjected to contact with the pavement, under load Through this localisation of the strain the extensive and continued stretching of the rubber of the tire is eliminated and tires of this type deliver mileages greatly in excess of those secured from the simple solid tire

Furthermore, such displacement notches or other recesses furnish positive grip to any kind of a road surface, which will enable the truck so equipped to negotiate snow, sand, mud or slippery pavements without the use of chains. Such tires give from 15,000 to 30,000 miles of service at an initial cost of one-half that required for a pneumatic of equal capacity

The notches in such a semi-solid tire permit the displaced rubber to flow easily and freely The resiliency of such a tire is much greater than that of a solid and even approaches that of a properly inflated pneumatic The hammer blow struck by such a tire when it travels over an obstruction in the road is absorbed by the live, elastic rubber which, instead of being forced out into the form of a bulge on each side, is merely moved or displaced into the adjoining notches which are placed at exactly the correct intervals through the circum ference of the tire, on each side

Even the tread of the pneumatic tire may be subjected to the destructive traction wave The tread of a pneumatic tire is a comparatively thick layer of rubber placed over a carcass While the interior of the tire itself is filled with air, the thickness of this rubber tread produces a flattening of the rubber itself This rubber is no more compressible than is that of a solid tire and consequently the flattened tread must "flow" in some direction If there is a smooth central strip on the pneumatic tire of a considerable area, the tread will be stretched and pulled as the traction wave travels. This causes tread separation, which can be avoided by the use of a non skid surface composed of small cross-bars adjoining open spaces of a size sufficient to absorb the displaced rubber Thus, pneumatic tire manufacturers have learned from the experience of solid tire manufacturers the best means for overcoming one of the most destructive elements attendant upon the operation of the modern tire

Many other engineering and scientific considerations enter into the design of the modern truck tire. The use of a rubber compound giving exactly the proper resili ency together with the correct attention to wearing qualities is a matter of labora tory experiment Each tire manufacturer may employ his own methods and he may evolve different chemical formulae The truck owner of today, however, is given the best product of the tire maker's art and, except for the experimental stage in which the larger sizes of truck pneumatics are still to be placed, he may select his tire equipment with the assurance that he is obtaining his full money's worth

EVERY truck user and everybody who sees trucks making their ponderous way through streets and over roads must have observed that, as Mr Slauson says, there are three principal types of tires We have the plain solid tire, the semi-solid type, and the pneumatic The layman might hesitate to classify the solid tire and the notched one so boldly in different groups, but Mr Slauson makes it clear that this should be done And he makes clear, what might have been suspected, that there is no general answer to the question "What kind of tire shall we use on our trucks?" It all depends upon what we are going to do with our trucks what sort of loads we are going to carry, and what sort of roads we are going to meet But Mr Slauson can tell it better than we can, so we leave it to him.—THE EDITOR

Restoring Sight to Blind Animals

AT a general meeting of the Vienna Biological Society and the Ophthalmological Society of the same city, a young biologist named Th Koppanyi, a student under the well known biologist, Prof Przibram, announced the results of his studies upon blinded animals

His studies were based upon the experimental discovery that when either mice or fish have been blinded their coloring becomes dark instead of gaily ornamental as usual But when he transplanted into the eye sockets of blinded fish and batrachians the eyes of similar animals, the former recovered their original bright coloring This led him to conclude that the transplanted eyes had thrived in their new situation, so as to restore the sight of the animals operated upon. Pursuing his experiments with frogs and toads, he obtained further proof that the animals regain their sight. He then extended his researches to warm-blooded animals. He blinded a rat in both eyes and then transplanted into the eye-sockets of his animal the eye-balls of another rat He soon obtained proof that both the retina and the optical nerve had resumed their proper functioning Furthermore, microscopic examinations made by Prof Kolmer, demonstrated the new eyes to be entirely normal and capable of functioning It was found that the end of the transplanted optical nerve grew on to the amputated end of the nerve in the eye of the first animal These conclusions afford hope that human beings may eventually be entirely relieved of the affliction of blindness.

The Banana and Its Uses

Getting Acquainted with This Tropical Fruit of Which There are Over Seventy Varieties

By William A. Murrill, Ph.D.
New York Botanical Garden

THE banana plant has been intimately associated with the primitive inhabitants of many parts of the tropics since prehistoric times This is due to the ease with which it is cultivated and propagated the luxuriance of its growth and the abundance and food value of the fruit it bears It was native to India and either grew naturally or was a very early introduction in other parts of tropical Asia Africa Australia and the islands adjacent preferring hot low regions where water and fertile soil were abundant

The northern limit of its cultivation in the open is southern California and Louisiana Florida the Canary Islands Egypt and southern Japan and China Few of the varieties will endure even a slight frost

There is no definite evidence of its occurrence in American previous to the advent of the white man the claim being made that the first banana plant was brought to Haiti from the Canaries by a Dominican in 1516

A typical banana plant although tree-like and somewhat resembling a palm is in reality an immense herb the false stem being made up of overlapping leaf stalks This so-called trunk may reach a height of twelve to twenty feet or more and a thickness of one foot while the leaves are so large as to be used for umbrellas in some countries being six to ten feet long and two feet across The massive root stock persists year after year underground sending up new shoots as the old ones fruit and die away

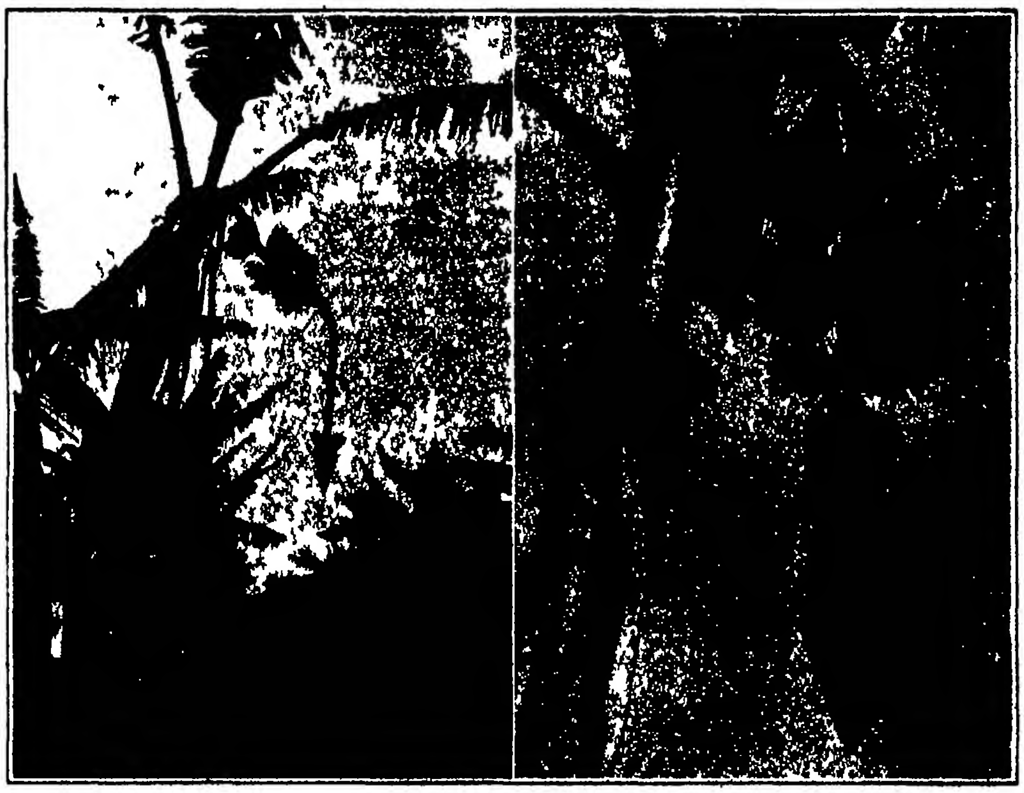
When old enough to flower a true stem develops from the rootstock and grows up through the hollow center of the false stem producing at its apex a single long flower cluster which is either pendulous or erect This cluster is in the form of a spike bearing large colored bracts which cover the inconspicuous tubular red or yellow flowers clustered at intervals on the main axis

The first flowers to be seen near the base of the spike when the bracts fall away are female and give rise to the fruits while the later flowers are male and bear the pollen The large bud or knob at the tip of the cluster is simply a number of these leafy bracts which will never open As the fruits increase in size the axis elongates and gives them room to grow A bunch of fruit is made up of several hands or layers and each hand is composed of a number of individual fruits or "fingers When a bunch is cut it is inverted and hung up by the 'tail or that portion of the floral axis which bears only sterile male flowers

There are nearly seventy different species and over two hundred cultivated varieties of bananas in the world but most of us are acquainted only with the yellow and red fruits seen in our markets and with a few species like *Musa sebrina M coccinea* and *M Cavendishii* with colored foliage or attractive flowers, grown for ornament in our glasshouses The species most cultivated for decorative purposes is probably *M ensete*, a native of the mountains of Abyssinia. It is the largest species known and at the same time one of the oldest being represented in the ancient Egyptian sculptures. The leaves are red along the midrib the flowering spike is erect with dark bracts and white flowers and the fruit contains black glossy seeds nearly an inch in diameter, from which the plant is easily grown

In tropical countries, all parts of the banana plant are used. The leaves protect from the rain, serve as tablecloths, as wrappings for food during the process of cooking, and for various kinds of packing. When cut into strips and plaited they make serviceable mats and bags Cigarette papers are manufactured from the pulp of some species All parts of the plant contain a watery juice which blackens on exposure to the air and forms an indelible stain This juice, usually obtained by 'bleeding" the young fruit-bunch, is used for marking cloth and decorating various household utensils.

Valuable fibers, suitable for the manufacture of ropes, clothing, etc., are obtained from the leaf stalks of many species, especially the one known scientifically as *Musa textilis* which supplies the abacá or Manila hemp, of commerce. This species is a native of the Philippine Islands, where it is extensively cultivated Unlike our ordinary banana, it bears seeds and the fruits are not edible Plants are grown from seeds, root-cuttings, or suckers and they mature in from two to five years, reaching a height of from six to fifteen feet A plantation is cut over about every eight months after which new plants grow up from suckers



Left Banana plantation in Cuba with special reference to the long hanging stalks from the trees. *Right* Young fruit and male flowers on a growing stalk in Costa Rica

The banana and how it grows

Immediately after cutting the outer fibrous parts of the leaf stalks are removed in long strips with bone knives and taken to the machines, where the fibers are pulled out between the edge of a long knife and a block of wood pressed against it by means of a pedal. This is very strenuous work especially for a tropical climate, and if a man cleans twenty five or thirty pounds of the fiber a day he is doing fairly well

The outer layers of the leaf-stalk supply coarse strong fibers used for ropes of various sizes, while the finer fibers used in the Philippines for hand-woven cloth come from the inner layers. Practically all of the abacá fiber exported is manufactured into rope and twine, its strength being nearly twice that of sisal fiber The heavy cordage used on ships is made into Manila paper when too old and worn to be any longer serviceable.

The fruits of various species of bananas, and sometimes even the rootstocks, are very extensively used for food, taking the place of bread and potatoes in many parts of the tropics. They are baked or fried, stewed as a vegetable, dried and beaten up into a flour or meal, dried in the sun like figs, preserved with sugar and vinegar, or pressed and fermented, yielding a kind of cider Wrapped in banana leaves and cooked in a fire-pit similar to that used for beans, they have a flavor all their own. Most bananas are used in the cooked form in the tropics, but the one most used in this way is the plantain, which is too coarse and poorly flavored to be eaten raw

The plantain, or Adam's fig, *Musa paradisiaca normalis*, is a large variety native of India and now distributed in many forms to all parts of the tropical world The leaves are green, the flowers yellowish-white, the floral bracts violet, and the fruit large, distinctly ribbed and yellow when ripe, but usually cooked when still green, having in its unripe state an agreeable starchy taste. The common banana found in our markets is really a variety of the plantain and would be rendered more digestible by proper cooking. In East Africa there are some 'cooking bananas' with fruits two feet in length and as thick as a man's arm. A curious species in Cochin China called *Musa corniculata* bears only a single fruit, but it makes a meal for three persons.

The so-called "fruit bananas, cultivated for commercial purposes or for local consumption in the ripe state, vary greatly in size, appearance, and flavor in the different countries. The best ones are too perishable for ordinary marketing and are obtained only by visiting the regions where they grow The Dominico," a short yellow variety much esteemed in Mexico can be shipped only a few miles while the best banana in Jamaica, known as the 'fig banana or 'lady-finger," — a very small, thin-skinned, yellow variety with sweet, delicate flavor — is practically unknown to our northern markets, although shiploads of bananas arrive continually from Jamaican ports. The same may be said of the datil" or date banana and the manzana or apple banana, of Cuba, which are highly esteemed in their own country but not exported

Most of these fruit varieties are forms of *Musa paradisiaca sapientum*, to which group our common yellow 'Martinique" variety belongs Red varieties are no better in flavor but usually require more care in shipping. The ancient Hawaiians recognized at least twenty varieties of this group, all brought with them at an early date, along with the sweet potato and the bread-fruit, from their primitive home in the South Pacific

Some of these varieties are very curious. In one, the bunch of fruit is small and ripens within the stem of the plant; another bears fruits shaped exactly like a hen's egg, in another the young fruits are red instead of green, and still another variety bears from two to four bunches of fruit to the plant instead of the usual single cluster.

Musa Cavendishii, a distinct species from China, has small fruit, but it is a good shipper and the plant, being small, endures cold and stormy weather better than almost any other species. It is the standard banana cultivated in Hawaii, having been introduced from Tahiti about 1850. Its leaves are [illegible], the floral bracts reddish-brown, the flowers yellowish-white on drooping spikes, and the fruits fragrant, [illegible] and of fairly good flavor. The [illegible] variety so [illegible] in English markets belongs to this species.

Although a few [illegible] reach the [illegible] markets of [illegible] and [illegible], we are [illegible]

[illegible] with the cultivation of the ordinary banana of [illegible] northern fruit-stands, grown in large commercial [illegible] in Jamaica, Costa Rica and other parts of [illegible] America. It is known by several names, [illegible] the "Martinique," the "Jamaica," and the "[illegible]." In Jamaica, it is called the "Dominica," while in Cuba it is known as the "Johnson." Being large, handsome, of fair flavor, easily grown, and probably the best shipper, this variety has held its own against all rivals even though the "Red Jamaica," or "[illegible]," looks better and many varieties from India and elsewhere are more finely flavored.

The banana plantation must be located on low ground near the coast or in a rich valley, where there is plenty of water and deep soil rich in humus. Drainage is also important, and this is often effected by numerous deep ditches running at right angles through the plantation. Grass is kept down by cultivation and by sowing cowpeas and other green manures. Fortunately, there are few diseases that affect the plants when once established under proper conditions.

Seeds being unknown in the varieties ordinarily grown, the plants are propagated by suckers or cuttings from the rootstocks, which are set out fifteen feet apart each way or in blocks of four planted twenty-five feet apart. The first crop of fruit appears on the new plantation in from twelve to eighteen months, after which there is a regular supply from plants produced by suckers until it seems wise, after ten or a dozen years, to discard the old stock and begin with fresh cuttings again. A convenient method of assuring a uniform succession of crops is to keep about four plants of various sizes in a hill, and, when the oldest matures its bunch of fruit and is cut away, to train up a new sucker to take its place eventually

The banana is a voracious feeder and the most prolific fruit-bearing plant known. A single bunch grown on one stalk may contain over one hundred and fifty fruits and weigh as much as eighty pounds. With six hundred to eight hundred plants to the acre, it is easy to estimate the enormous yield, amounting to forty-four times that of the potato and one hundred and thirty times that of wheat.

When the fruit is fully grown but still green, the clusters are cut and shipped northward as quickly as possible, good organization and complete telephone connections between the docks and the plantations being essential to success in this particular On the ship, they require good ventilation and a moderate temperature, never falling below 50 deg. F., which would injure their flavor and prevent them from ripening properly

In the winter, the storage rooms and docks must be artificially heated. If needed at once for the market, they can be ripened in two days over charcoal fires in tightly sealed rooms. Unlike many fruits that are gathered in the green state, the variety of banana which we buy at the fruit-stand differs little in taste from the same variety ripened in the tropics. But it is often grown on very poor soil for home consumption, thus improving its quality while reducing its size. A process recently invented for drying ripe bananas should prove of great value, and this would also enable the northern buyer to secure the very best varieties of fruit known.

The introduction of the banana into the United States is comparatively recent. In 1804, the first lot of only thirty bunches was imported, and, in 1830, the first full cargo of fifteen hundred bunches arrived in New York harbor from Baracoa, Cuba. The first bananas from Jamaica were introduced in 1869, and since that time the industry has steadily increased to enormous proportions, about two hundred steamers being engaged in the trade. Many of our bananas still come from Jamaica, but more of them from Central America.

The starch in the green banana changes into sugar as it ripens, and the pulp is rich in mineral salts, as well as free from germs because enclosed in a protecting skin. Ripe bananas are said to contain 12 per cent of digestible food. A man would have to eat eighty a day to obtain sufficient carbohydrate food, and twice that number for the necessary proteins. This explains the unusual abdominal expansion in regions where the banana is the principal food

A great deal has been written about the digestibility of the banana as we buy it, which would have been unnecessary but for the experience and observation of a good many discerning persons. When eaten before thoroughly ripe or gulped down without mastication, it is not surprising that it often causes discomfort Mixing it with bread or cereal prevents it from forming a mucilaginous mass in the stomach and thus promotes its digestion, while baking it quickly in the skin until soft and juicy renders it perfectly harmless for most persons.

Recent Studies of the Venomous Snakes*

New Light on Their Behavior in Attack and Defence, and on the Chemistry of Their Venom

By J. Beyer

During the past thirty years I have made many observations upon venomous serpents, have experimented with snake venom and its constituents and have endeavored to determine its effects upon both cold and warm-blooded animals. I have experimented mainly with cross adders and sand vipers. At first I observed the serpents in a state of freedom from a suitable distance, and found that on sunny mornings they leave their nooks of retreat in holes in the earth, etc., very early, taking up a position in damp but sunny edges of the forest and in meadows where they watch for their prey, quickly taking flight, however, when there is an unfavorable change in the weather or when disturbed by men or hostile animals. Snakes are less lively and less eager to bite when the temperature is low and when they are sated with food; when they are surprised by their enemies, they quickly become worked up into a state of rage and eagerness to attack They usually allow men and the larger animals to pass in peace and only attack them when alarmed by their close proximity. The act of biting is preceded or followed by a brief warning hiss. . One day I caught a large water frog and took it to a pond where I knew that a large copper-colored adder was in the habit of sunning itself. I allowed the frog to hop down at a distance of about 80 cm. from its enemy which it spied at once. Trembling in every fiber it began to utter a long-drawn complaining croak and moved toward the adder with quivering limbs. The coiled adder hissed, thrust out its tongue, drew its lifted head backward and, moving the upper ring of its body, buried its fangs in the left breast of the frog. The sound of the stroke was like that of a piece of paper through which a pen is thrust. By means of a jerk the snake then let go of the body of the frog, placed itself again in a position of watchful waiting and uttered a hiss. The frog at once began to swell in the vicinity of the bite and died, exhibiting symptoms of paralysis. The holes made by the fangs were recognizable by two blackish spots which visibly grew larger; at the end of about two hours the corpse of the frog was uncommonly bloated, slimy, and dark grey in color The adder, meanwhile, had plunged into the pond where it swam rapidly away with its head above water.

I [illegible] proceeded to catch various small animals, such as [illegible] hedgehogs, sparrows, crows, etc., and used them to experiment with snakes enclosed in a large glass box. The [illegible] nearly always strikes its fangs into the soft breast of its victim, then stares stonily at it, holding itself in readiness for a second stroke, and not proceeding to eat it until the quivers of death have entirely subsided. Nearly all the smaller animals seem dazed by the eye of the adder and not only do not seek to flee, but even move towards the dreaded enemy with trembling limbs and cries of alarm. After receiving the death wound most of the victims show signs of paralysis and loss of consciousness—death usually occurring in a few seconds. One hot August day I was able to observe the behavior of the well armed hedgehog toward an adder. The hedgehog was a strong, hungry and very active animal, while the adder was an old female which moved excitedly about in the box when it saw its greatest enemy nearby. For a short time the hedgehog lay still in the box while the snake coiled hissing in a corner, then the hedgehog carefully concealing its snout and its legs moved toward the snake. It then crouched flat against the ground and whenever the snake attempted an attack drew itself together at the proper moment so as to present its quills to the snake, which it soon succeeded in touching. The serpent then dashed blindly into the quills and raised its bleeding head and tried to flee, but the hedgehog instantly seized it by the neck and bit its head off clean. It then proceeded to devour the lashing body of the snake leaving the head untouched and always carefully avoiding it in its rambles about the cage.

Those animals which eat snakes, such as the hedgehog, the fox, and some eagles, appear to have an instinctive fear of the deadly properties of snake venom and to know how to distinguish between poisonous and nonpoisonous kinds of serpents. They never eat the head

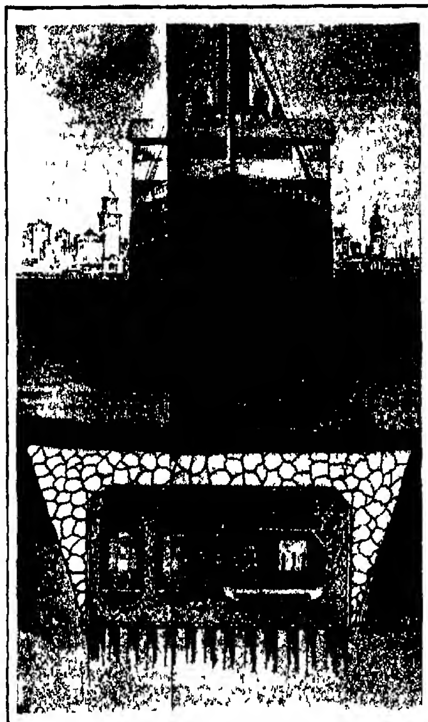
Later I injected snake venom into a hedgehog, which promptly perished like all other animals so treated, showing that it was not immune. Snakes do not bite their victims as other animals do which press the parts of the body of their prey between the jaws and then bite, but open the mouth to its full width and then strike with the upper jaw, which is movable somewhat like a winch with a sliding rod The blow is made with the firmly fixed fangs embedded in its upper jaw and the lower jaw exerts little or no pressure The wound never shows any damage done by the teeth of the lower jaw After the blow has been given the snake jerks its fangs free with a swing of the head I then endeavored to collect as much of the venom as I could, so far as possible from large and hungry snakes. By a blow upon the neck, I made a snake motionless, grasped it in a cleft stick, thrust a cylindrical lamp chimney into the mouth and exerted pressure upon the eyes with a small wooden fork. In this manner I obtained the two drops of poison of varying size, consisting of a yellow fluid with a nauseating odor, which promptly dried into a yellow mass in the air and which in this condition can be kept containing its deadly powers for many years. The venom is in a uniform body, it consists of albumen (venom globulin and venom peptone), together with salts of calcium magnesium and other elements. Cobra poison is quite different from that of the adders. I took a glass of distilled water and shook some of the snake venom into it The yellow powder at once lost its color, falling to the bottom as a white precipitate consisting of the venom globulin This is an insoluble substance which prevents the coagulation of the blood. For this reason, not only the non assimilated blood issues from the wound but all the capillaries in the victim's body pour such blood into the tissues The venom globulin is not able to penetrate tissues and membranes (intestinal walls) and for this reason when it is swallowed it passes through the body without doing any harm

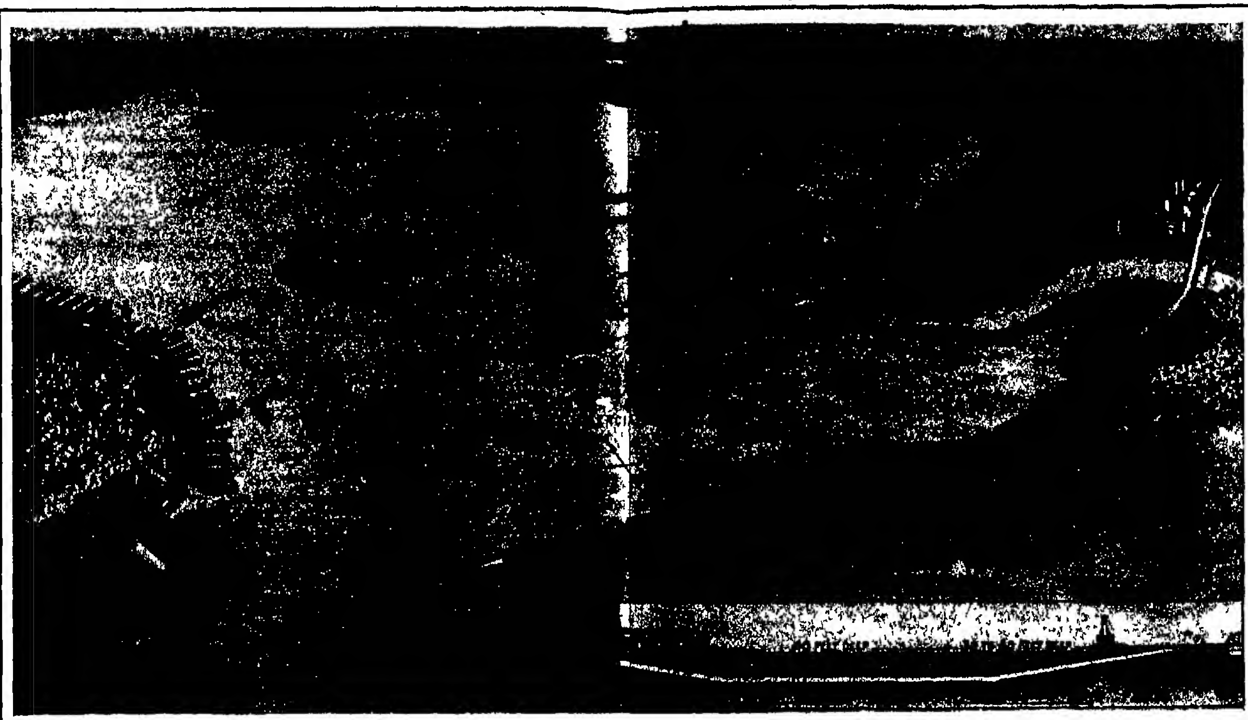
The venom peptone is soluble like all of the alimentary juices. Animals which were given water containing the venom peptone died very shortly from severe intestinal disturbance The venom peptone at once penetrates the intestines, the skin, and all tissues and membranes, causing them to swell and decomposing them immediately, inducing putridity It also immediately affects those parts of the brain which govern the respiration, on which account animals poisoned with it die from suffocation with symptoms of paralysis. In all experiments and cases of accident it is important to know what part of the body was exposed to the venom and what sort of poison was present in predominating quantities, since upon this depends the degree of danger In the various venomous serpents the percentage of these two kinds of poisons is very variable, while the venom of the cross adder contains about 45 per cent of the peptone and 55 per cent of the globulin, that of the rattlesnake contains about 50 per cent of each, while that of the cobra contains only 20 per cent of the globulin and 80 per cent of the peptone.

On this account the poison of the cobra and of the Indian haje whose greater part consists of peptone, is particularly dangerous, since the poison at once penetrates all membranes of the body, causing death The wounds at once begin to be painful, since the venom immediately penetrates. Most dangerous of all, as a rule, are wounds made by snakes in captivity, since their glands are apt to be over full of poison The more excited, heated or fatigued the victim, the more rapidly the venom works, causing a struggle for breath and paralysis of the brain.

The process of healing is extremely difficult and tedious in case of recovery, since the dead and decomposed tissues find it hard to renew themselves and on this account the wounds should have the poison pressed out or sucked out as much as possible and the area of the bite cut out Snake venom is neutralized by alcohol and alcoholic products, and by vinegar etc When snake venom is mixed with a gram of ordinary water containing an equal weight of potassium permanganate its effectiveness is entirely destroyed Animals can even be inoculated with this mixture without injury, not even any temporary disturbance being usually visible

*Translated from Kosmos (Stuttgart) for Scientific American.





Center Airplane view of San Francisco Bay between San Francisco and Oakland, showing the proposed railroad and highway crossing, which will include a 3540-foot subway, 11,500 feet of bridge, 3600 feet of pile trestle, and a 12,000-foot fill *Left* Cross-section of subway *Right* Perspective detail view of the bridge portion of the crossing, showing the roadway, footwalk and two railway tracks

Crossing San Francisco Bay by Bridge, Fill and Tunnel

Engineers Propose a Six-Mile Vehicular and Railroad Structure Joining San Francisco and Oakland, California

IT will take the future historian to appraise at its full value the influence which the motor car has exerted in the development of transportation facilities What it has done in stirring up the country to build a system of highways is well known but not so well understood is the influence of the motor car in promoting the construction of great bridges and tunnels which, but for this urge, would have remained upon paper and in the shadowy realms of theory for many years to come

Here in New York the automobile interests are as strong as if not stronger than, any other in the promotion of the great suspension bridge whose construction will shortly commence across the Hudson River In deed, it is planned to complete the upper deck, which will be used for motor and general vehicular traffic, first, and throw it open at once to the public Statistics of travel show that, from automobile tolls alone, there will be available a sufficient revenue to cover all the fixed charges on this great structure

And now it appears that, on the opposite side of the continent, where, at San Francisco, they possess natural harbor facilities, present and prospective, which match if they do not exceed those of New York, the growth of automobile traffic has been such that the motor car interests have combined to urge the carrying through of the construction of a great highway and railroad structure extending for six miles across the Bay from Oakland to San Francisco It seems that there is on the Oakland and Alameda side of the bay a congestion of automobile traffic which at times entirely swamps the existing ferry boat service across the Bay to San Francisco Indeed, the situation here is similar to that presented on Sundays and holidays along the western bank of the Hudson River and it is claimed by those who have had experience at both localities that the San Francisco problem is just as serious as that at New York Be that as it may, the Motor Car Dealers' Association, the Associated Newspaper Committee, and the General Bridge Committee, united their forces and invited J Vipond Davies, who was associated with Mr Jacobs in the construction of both the Pennsylvania and the Hudson tunnels beneath the Hudson River, and also Ralph Modjeski, the well known bridge engineer, to visit San Francisco, look over the various plans, both bridge and tunnel, for crossing the Bay, and make their own suggestions as to what would be the best solution of this great problem This report was made during the past summer and the illustrations accompanying the present article are based upon that report The engineers state that the main question is the adoption of a plan which will meet with the approval of the War Department, which will represent the most reasonable cost of production, which will combine reasonable cost of operation and maintenance, entail upon the traffic the least measure of expense in operation and the least inconvenience, and which will present the least permanent interference with navigation

Route of the Proposed Crossing

The line of the proposed crossing of the Bay commences at any convenient point between Mission Rock and Petrel Point in San Francisco, and extends thence due east to the boundary line, north and south, between the counties of San Francisco and Alameda Here it enters the property which has been set aside for a proposed navy base It then extends across the westerly portion of Alameda Island to the Oakland estuary near the foot of Broadway, Oakland, from which point excellent distribution of traffic can be made into the street system of Oakland The airline distance between the City Hall, San Francisco not far from which the crossing terminates, and the City Hall of Oakland, is 8.13 miles, and the driving distance by motor car is 9.38 miles From the terminal point in San Francisco the line will descend in tunnel and, swinging to the left, will pass beneath the main ship channel between the upper and the lower bay It will descend to a depth which will permit of fully 40 feet of water in the channel at low tide, and this full depth will be available for a width of 1500 feet in the channel The tunnel will then rise on such a grade as will give an additional width of 2500 feet, in which the water depth will be 20 feet at mean low water After crossing beneath the channel, the tunnel will emerge above the level of the water, and the structure will pass on to a bridge, which will extend across the comparatively shoal center portion of the bay until near the opposite shore, it reaches the westerly channel at the 30-foot contour line Here the crossing will consist of a concrete-pile-and-slab-deck structure, which will extend for 3600 feet across the channel From this point across the Navy Yard site and Alameda Island, the crossing will be a fill or embankment.

Type of Tunnel Construction

The engineers offer two types of tunnel construction, both of which are feasible for the San Francisco channel crossing One system, as shown in our illustration, consists of a large and heavy rectangular cast iron tube, which would be built in sections and would rest upon a continuous foundation of piling Within this tube would be three cast iron tunnels, one containing a 20-foot roadway, and each of the other two carrying a railroad track The three tunnels would be separate and embedded in the mass of concrete with which the whole of the outer casing would be filled

The alternative method to this is the well-known circular shield-driven tunnel, consisting of a circular cast iron shell with an interior line of concrete. This is the type which has been used in the East River and Hudson tunnels at New York.

The Question of Ventilation

The engineers express no anxiety as to the problem of ventilation. This is due largely to the fact that they have at their command the results of the elaborate tests, which have been carried out to determine a satisfactory system of ventilation for the vehicular tunnel beneath the Hudson at New York. These tests have been discussed in previous issues of the SCIENTIFIC AMERICAN They were made in cooperation with the United States Bureau of Mines, the Physiological Department of Yale University, and the Engineering Department of the University of Illinois, and it was found that, by means of a system of properly designed ventilation, the dangerous gases could be diluted to a point where they would be harmless. The method proposed for the San Francisco tunnel is that known as "transverse application." This consists in blowing in fresh air at the roadway level throughout the whole tunnel section and removing the foul air through continuous openings at the roof. This has the advantage of removing the gases by the shortest route to the ducts, which is, of course, in a direction transverse to the direction of traffic It avoids any draft blowing in either direction along the axis of the tunnel In the opinion of Mr Davies the length of the San Francisco tunnel comes well within the practicable limit for safe and thoroughly satisfactory ventilation At the outer end of the tunnel, where it rises above the water surface, there will be erected a combined power station and light house, the latter serving to mark the limits of the channel In the former will be installed the ventilation machinery

The Great Central Two Mile Railway Bridge

The next 11,500 feet of the crossing will consist of about forty 300-foot truss spans which will carry two railway tracks, a 40-foot roadway, and a sidewalk The general character of the trusses and the appearance of the roadway are shown in one of our detailed sketches. It is not anticipated that there will be any unusual difficulties encountered in this part of the structure The water is comparatively shoal, and the sub-structure will consist of concrete piers sunk either to bedrock or raised upon piling driven to a firm footing. The last pier of this section will be placed at the edge of the open waterway which extends parallel with the county line between the counties of Alameda and San Francisco From this point for the next 3600 feet the structure will consist of concrete piles capped by reinforced concrete slabs which will form the superstructure for the roadway and railway tracks. From the end of the pile trestle the structure will consist, as we have said, of a great fill 12,000 feet, or over two miles in length. It will be noticed that this fill will cross the site of the proposed Alameda naval base The engineers state that if this site should ever be utilized as a naval base, and if the Navy Department wished to connect the two portions of the areas after they have been filled in and reclaimed from the Bay, the highway and the railways of the fill could be roofed over, and the filled lands graded up on both sides. In other words, the structure could be made a depressed subway across such portions of the land as might then be found desirable

Cost of the Structure

The engineers estimate that the total cost of this vast project would be forty million dollars, of which thirty five millions would be for actual construction engineering, and administration, and 4,820,000 dollars for land damage to property and interest on cost of money The annual fixed charges at six per cent would be 2,400,000 dollars. The proposed toll per passenger would be five cents, and 75 cents for each vehicle which is less than the present automobile ferry toll To this would be added receipts from railroad freight movement and from certain concessions such as for electric ducts The aggregate receipts from these sources during the first year of operation, it is estimated, would be 1,592,500 dollars, rising to 2,850,000 dollars in the third year and 3,030,000 dollars in the fifth year

Fire Tests of Building Columns

IN cooperation with the Associated Factory Mutual Fire Insurance Companies and the National Board of Fire Underwriters the Bureau of Standards has conducted a very thorough investigation of the fire-resistance of building columns and has recently issued Technologic Paper No 184 on this subject which is for sale at 75 cents per copy by the Superintendent of Documents, Government Printing Office, Washington, D C

The fire exposure test was produced by placing the column in a gas-fired furnace at the same time the pre-determined working load for the column being maintained constant during the test In certain cases not only the resistance to fire but resistance to fire and water was investigated. In this case the column was loaded and exposed to fire for a predetermined time after which the doors of the furnace were opened and a hose stream applied to the heated column, the severity of the test being regulated by the degree of resistance developed by the corresponding type of column in the regular fire tests. The paper reports 91 fire tests and 17 fire-and water tests.

In the case of columns protected by a fire-resisting material, the latter was obtained from the main producing regions of the country, in order to secure truly representative material Care was taken in erecting the columns and coverings to duplicate as nearly as possible actual building practice The test results are presented in 12 tables and 128 figures and diagrams the latter comprising views of the columns before and after test the time-temperature curves for the furnace and numerous points on the test column as well as unit deformation with corresponding average column temperature curves

The results are summarized in terms of hours and minutes of fire resistance offered by the different types of columns and protection The resistance period is taken as ⅘ of the average time to failure in the fire tests, the deduction being made to allow for incidental variations in material and workmanship of columns and coverings as tested and as installed in buildings and also for differences in load and fire conditions

The resistance periods thus derived vary from 10 minutes for unprotected steel columns to 8 hours for similar columns covered with a 4-inch thickness of concrete made with fire-resistance aggregates and reinforced concrete columns made with the same aggregates.

Freak Boiler Explosion With a Man Inside

ONE of the most unusual or "freak" boiler explosions that has ever been recorded actually took place at a plant in New Jersey near Newark

The boiler was of the stationary locomotive type and had been out of service a long time At the time of the explosion the inspector was inside the fire box searching for defects, and he certainly found one He was naturally rather startled to hear a report like the discharge of a cannon and at first thought that a stick of dynamite had exploded He found however that a furnace sheet had ripped open for a length of about 8 inches directly through a weld that had been made in the sheet The rupture extended about equal distances on either side of the part built up by welding.

The explanation of this peculiar occurrence is thought to be that the sheet had been overheated in the welding process crystallized and was therefore under a severe shrinkage strain The defective part was practically free of scale The handhole plates at the bottom of the boiler were off, but the manhole plate had been replaced

The incident is certainly a forceful demonstration of the dangerous stresses that may result from improper heating in the welding process.

How Marine Worms Catch Their Prey

A Study of These Interesting Forms of Sea Life, Which Abound in Great Numbers and Wide Variety

By William Crowder

TO the true naturalist, no creature is ugly. The serious business of his life removes him from the prejudices inspired by superficial appearances. The lay public, however, does not always share this happy indifference. It ofttimes regards as forbidding and even unworthy of consideration many animals, which a more familiar acquaintance would reveal to be not only prepossessing but genuinely interesting. Of those animals universally held in contempt, few are shunned more than the worms. Nor is this aversion entirely without reason. The unwholesome experience of mankind gained largely through contact with the degenerate forms has done much to create in his mind an antipathy toward all related members of the family. Consequently there has been a marked apathy in regard to these creatures and little or none, of that interest which ordinarily attaches to the lives and habits of more favored animals has manifested itself generally. Nevertheless there is much to recommend these lowly creatures to our consideration and a charitable inquiry of their ways will amply repay the investigator.

By far the greater in number both in species and individuals are those worms which inhabit the sea, and it is here that we find every type from the lowest to the highest, from the most abhorrent to forms exquisitely beautiful. Forms which in richness, variety and harmony of color are surpassed by no other animals. All show marvelous adaptations to their environments, many exhibit uncommon ingenuity in the construction of their homes and not a few betray an intelligence superior to numberless creatures more highly organized. Indeed the simple organization of the worms, when contrasted with the complexity of the life histories of many of their species, is one of the curiosities of natural science. So involved is the development of some of the most abundant forms that years of research have not yet worked it out. And still the revelation of these curious details is but one of the many features of never failing interest which entitles their claim to a greater popularity.

It is among the flatworms, the lowest division of the worms, that we find some of the strangest puzzles in the domain of biology. Some there are which begin life as males, later however they lose their masculine characteristics and become females. Others again seem to have lost all functions of sex, reproducing their kind by the simple process of dividing into several pieces, each piece growing into a perfect adult which in turn repeats the extraordinary process.

The largest of the flatworms, and for that matter of all worms, are to be found among the nemerteans, a group characterized principally by the long protrusible thread-like proboscis that each individual carries. W. Saville-Kent, the English naturalist, in referring to the length of these worms says: "the so-called india rubber worm is remarkable for the extraordinary elasticity of its tissues. Black in hue it lives among the rocks and seaweeds and preys upon small fishes and other organisms. These being seized by the suctorial mouth are unable to effect their escape, the worm's body being capable of stretching out to a length of twenty feet or more and playing the captured victim like a living elastic fishing line until its struggles are exhausted."

The longest nemertean of our shores, however, is the ribbon worm, *Meckles ingens*. This animal, so commonly found secreted under stones or buried in the sand between tide marks, often attains a length of more than ten feet, its breadth being an inch or more. But in spite of its great length it is capable of contracting to less than a yard. In doing so, however, it loses its flattened appearance and becomes more nearly cylindrical. It is of varying shades of pink or flesh color, and is one of the rare instances wherein the appearance of the animal is in agreement with its popular name. It has no well defined head or other specialized regions of its body, and is extremely soft and delicate in texture. It can, nevertheless, burrow with great rapidity, which it does with the aid of its proboscis, and it also uses this organ in determining the location and effecting the capture of its prey.

And this latter is a sight never to be forgotten. Let me say at once that Meckles is a cannibal. It and I here use the neuter pronoun, for the ribbon worm is a hermaphrodite. It subsists largely on the smaller of its own species though it will not hesitate to attack other forms as large or larger than itself. When the ribbon worm comes forth from its hiding place at night,—for although it is blind it can distinguish light from darkness,—it meets scores of other nocturnal prowlers, among which are many of its own kind. As it extends itself with wave-like undulations over the stony bottom, its proboscis constantly darting here and there among the crevices searching out its victims, it suddenly comes in contact with another nemertean out on the same errand. Coming athwart the posterior end of the other, its adhesive probe encircles it with a tenacious hold. In an instant the entangled worm rapidly contracts and expands, executing many convolutions. It realizes its danger. But too late! The other is upon the writhing struggler and applying its distended mouth, proceeds to engulf its victim whole. Quite actively does it carry on this horrifying task, until it would seem that if there were no limit to its appetite there surely must be to the capacity of its digestive tract; yet, steadily and surely the one passes down the throat of the other until more than a half of its body disappears. Then a curious thing happens.

It may be observed here that the nemerteans have the remarkable power of regenerating lost parts, which thereby enables them to undergo astonishing injuries without fatal results. They can be cut completely in two and the fore-body will ultimately develop into a perfect individual, while the hind body will retain its vitality for days before dying. This division of the body can be accomplished by the animal itself, and seems sometimes to occur as a natural process. Now, this is what took place in the above instance with the worm who was threatened with extinction. The time had come when it decided that enough was enough, and availing itself of this facile method of escape, it constricted its body in the region of its free end and literally parted company with itself and its enemy. But that is not all. Immediately after its escape it met with another wanderer and straightaway subjected that unfortunate to the fate which it itself had so narrowly missed!

Now it sometimes comes to pass that Meckles devours a worm such as a nereid which grows numerous spines or bristles. In this event, these indigestible portions often work their way through the intestinal wall and out of the body. But this is in no wise disconcerting for the punctures heal rapidly, leaving the nemertean no worse for the experience. Still even this property of regeneration in nemerteans is surpassed by a lower group of flatworms, the planarians. These animals can be divided not into two but into several pieces, and each piece will live and function as an adult. On the other hand if they merely be mutilated instead of severed, bizarre forms will result from this modified tendency to regenerate.

When consideration is given to the thriving myriads of flatworms that exist it is quite evident that they are sufficiently endowed with means and ability to secure a plentiful supply of food, but to find raptorial organs and the instinct, even the intelligence, to employ them developed to the *nth* degree, we must look to the marine annelids, the highest of all worms. Here, too, the methods of capture are as unique as the armature is refined. Many of them are equipped with powerful jaws or grasping weapons and attack their prey openly, others utilize snares or operate devices ingenious as any to be found in nature.

Let us see how the blood worm conducts this little matter. *Polycirrus eximius* is a big name for this little animal, for it is not over three inches long, but it at least has the merit of being descriptive. It varies in color from amber to a deep crimson, and makes its home in the soft mud just below low water mark. The distinguishing feature in the appearance of Polycirrus is the crown of crowded tentacles which adorns its head. It is composed of transparent filamentous strands which are continuously contracting and expanding. The worm is capable of extending these to several times the length of its body, the while they appear as tenuous as the finest silk, and would be invisible but for the brilliant stream of blood pulsating through them. They serve the double purpose of supplying the animal with oxygen and food.

Buried in the ooze, the body of the worm is completely hidden from sight, but its tentacles ramify in all directions over and under the surface of the substratum. Perchance there comes its way a small crustacean in search of food. Swimming heedlessly, it brushes against the waving strands. Instantly it is arrested in its headlong course, limed like a bird in a fowler's trap, and at once the adhesive tentacles [illegible] in and sweep the luckless swimmer down into the maw of the hidden monster.

Not all the animals the blood-worm catches are swimmers, however; some are burrowers. It sometimes happens, too, that a sturdy creature, such as the young horseshoe crab, plows its way through the sand and strays into the deadly labyrinth. Then ensues a tug of war. The crab attempts to liberate itself by crawling away—and is generally strong enough to do so—but in the attempt it pulls against the adhering tentacles until their utmost point of elasticity is reached, whereupon they break. And then the little horseshoe pursues its way trailing behind it a score of writhing appendages.

To exert no more effort in the capture of prey than is required in the normal process of breathing is the ultimate in solving the food problem. This has been attained, nevertheless, by certain tube-dwellers, termed, in the language of science, Serpulida. Furthermore, these oddly endowed creatures have the added gift of beauty for their variegated colors and their conspicuous branchiate gills give them the appearance of delicate flowers. A constant circulation of the surrounding water is caused by the animal within its tube, and these currents produce a vortex which both bathes the gills and precipitates small organisms into its mouth.

These worms are represented in our water chiefly by the species *Serpula dianthus*, than which there is none prettier of its kind. They live in fairly deep water, and are seldom found near the shore unless washed up after a storm. They always build their calcareous tubes on rocks or shells, which objects serve as supports, or bases, to these frail tenements. Serpula, unlike other tube builders,—notably the mason worms, which construct their houses of agglutinated shell and mineral fragments, and the comb-worm, which cements grains of sand together in mosaic fashion in making its tube cone-shaped shelter,— manufactures its own materials. By that mysterious chemistry of the body it converts the compounds of the sea into a structure of imposing excellence.

Nearly all marine annelids have some pleasing feature which enhances them in the eyes of the beholder, but the palm of beauty must unquestionably be awarded to *Aphrodite*, the sea mouse, a worm whose appearance has excited the admiration of every age. To the untrained eye, however, it does not look like a worm and perhaps therein may lie the secret of its charm. This is unfortunate. Had the early observers of this animal known its identity it is within the bounds of probability that ere now many other members of the group would have shone in popularity by reflected light. Yet there is another animal which—though unmistakably worm-like in form—in coloration is not surpassed by Aphrodite itself and is far superior to that individual in organization and intelligence. This is *Nereis virens*, one of the highest of the bristle-footed annelids.

Nereis is the giant of its class, often measuring over eighteen inches. Seen in the clear water of a tide pool, the sides of its iridescent body adorned with gills of pearly pink, it is the verisimilitude of a glittering chain of blue-green opals flanked by precious coral. Every motion is accompanied by a play of brilliant prismatic tints. From under every gill projects a sheaf of bristles reflecting the luster of pure gold. But it is vain to attempt an adequate description of the ineffable nuances, the evanescent hues, that give to this creature its strange beauty. Graphic representation itself can never reproduce the charming colors caused by the diffusion of light on those translucent textures.

In these worms the sexes are separate, the males being much smaller than the females, and are less often seen except during the mating season, at which time they swarm the waters at night in enormous numbers. The females make interesting aquarium pets, and they can be induced to come from their retreats to be fed by hand.

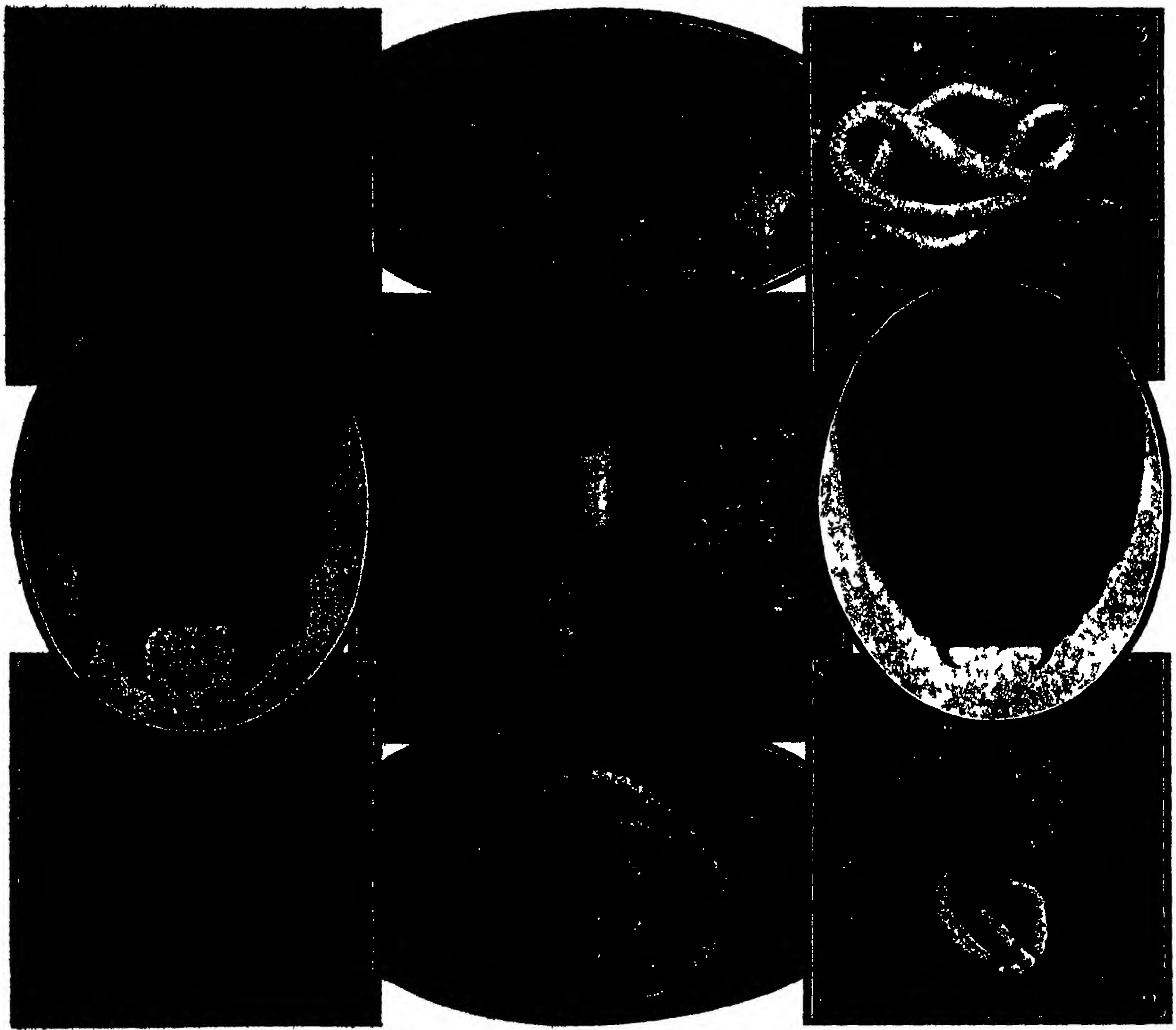
When young, Nereis sometimes is found occupying a shell in company with a hermit-crab. When the latter chances to come upon a morsel of food, such as a fragment of carrion, the worm concealed in the shell seems at once to become aware of the fact, and its head makes an appearance at the opening, under the fore-body of the crustacean. Then, [illegible], it extends itself and seizes a part, or all, of the crab's meal, and withdraws into the shell [illegible].

[illegible]

[illegible], somewhat like a pair of serrated ice tongs in action, they are attached by powerful muscles well back in the throat. The creature has well developed eyes and numerous feelers, or other organs, and when it comes into proximity with food or enemies (it is chiefly carnivorous, but will eat plants on occasion), it everts its armed pharynx much as one would turn the finger of a glove inside out. This action of bringing these formidable weapons into play is accomplished with lightning-like rapidity.

The writer once had under observation an adult female, which on being handled would give his fingers a threatening, but inconsequential, nip. On one occasion he neglected, for some reason or another, to supply her with food for several days. A live annelid fully [illegible] as large as herself, but of another species, was then introduced into her tank. No sooner did [illegible] aware of the other's presence than she made a desperate onslaught. Pouncing upon the new comer, which on its part was possessed of no inconsiderable strength, she, with the sheer force of her terrible jaws, bit it completely in two. Needless to say, she then proceeded to devour the crippled victim.

Much more could be said of her other activities of how she prepares her home, of how she conducts her courtship, of how she brings her progeny into the world—but, as Kipling would say that is another story which would take up much space in the telling.



1: *Nereis*, the sand-worm attacking a smaller annelid. This creature is fierce, active and voracious and will not hesitate to attack animals larger than itself. Photograph taken through the water. 2: *Cistenides*, the cone-worm. The remarkable structure with which this worm encases itself is fashioned from grains of sand cemented together in a single layer. The animal moves from place to place by pulling itself forward with the aid of its "comb," shown at the extreme right end. 3: *Glycera* the four-jawed worm digging its way into the sand with its protrusible proboscis. 4: The jaws of *Nereis*. These formidable weapons are normally carried in the worm's throat. This latter however is eversible and can present the jaws instantly. Enlarged about five times. 5: *Serpula dianthus* a tube dweller. The worm in this picture has built its house on the empty shell of a whelk. All that is visible of the animal itself is the gorgeous crown of feathery gills which projects from the top of the tube. 6: The jaws of *Glycera*. The four jaws, or hooks, with which the animal seizes its prey are located on the end of its protrusible proboscis which organ it is capable of projecting more than half the length of its body. 7: *Amphitrite*, the tufted-worm. This animal captures its prey by the numerous tentacles which surround its head. 8: *Meckica*, a nemertean worm. As shown here it is contracted; it is, however able to extend itself to several times this length. These are the largest worms known, full-grown specimens often attaining a length of more than eighteen feet. Its proboscis is here shown partly extended. 9: *Polycirrus*, the blood-worm. These brilliant worms trap their victims much as a spider does its prey but instead of making a web they use their crowded tentacles

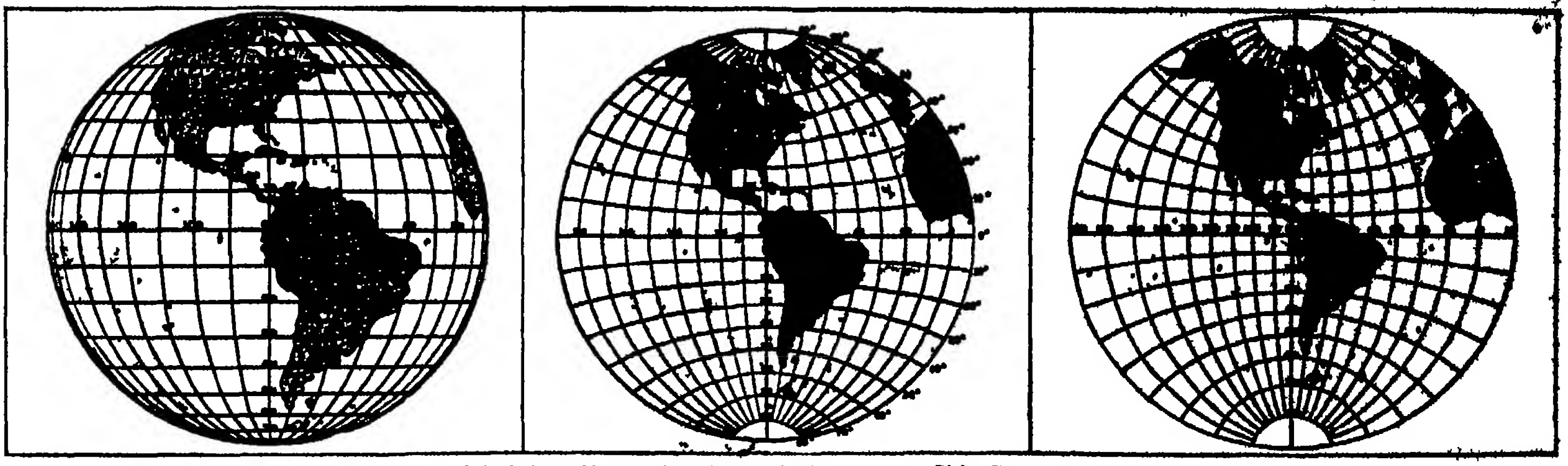
Worms which inhabit the sea

Tests have shown that the tube transmits vibrations better than a solid needle. Also, the reduced weight means a tremendous saving in energy. A phonograph record has to move the needle often as many as 5,000 times per second in reproducing the tones of the human voice or musical instruments. Replacing the solid needle with the tubular or Pentone needle is like substituting the lightness of a bamboo walking stick for the weight of a baseball bat. The lighter needle does not wear out either its point or the record as the heavier one does. One needle played a total of 502 records.

A New Phonograph Needle Shaped Like a Pen

A PHONOGRAPH needle designed on new principles has been invented by William Dubilier well known for his radio discoveries. In place of a solid shank it has a metal tube. The point is shaped like a pen but is only one-fourth as large.

When the Pentone needle lies on the record as a pen touches the paper when writing the tones are as soft as those produced by fiber needles and much clearer. If a loud tone is desired it is only necessary to give the needle a quarter turn. This invention is likely to prove a boon to the phonograph industry.



Left: Orthographic projection. *Center:* Globular *Right:* Stereographic

Three different schemes of mapping the earth, and their results when applied to a hemisphere

A Map's Other Name Is Ananias

The Various Projections Used in Representing the Earth's Surface, and What They Do to the Facts

By C H Claudy

DO you know what a map is? It sounds like a foolish question You will probably contend that every school boy knows If pressed for a definition you will probably say a map is a drawing which exactly represents a portion of the earth's surface the distances between points upon the map being proportional to distance between the points upon the earth represented or some similar explanation

But this is only partly true There is only one kind of map in existence which will truthfully fit such a definition, and that is a map made upon a globe No flat map large or small exactly represents any portion of the earth's surface and only on a globe are the distances between all points truly proportional to distances between points on the earth represented

In other words all flat maps are distorted All flat maps tell only a part of the truth All flat maps to some extent misrepresent the facts

This is not due to any lack of moral sense on the part of the map makers They can't help it The nature of a globe is such that there is no process by which its surface can be flattened out without tearing stretching, cutting or compressing And the earth is a globe (slightly flattened at the poles

If the earth had happened to be a cylinder maps would all be truthful A cylinder can be slit length wise and, with the ends removed, its surface flattened out into a square or oblong plane Had the earth chanced to be a cone maps of it could be made with perfect accuracy for a cone, like a cylinder can be slit and unrolled Or had the earth been a cube or a polygon we could make accurate maps of what was upon its many sides

Nature however decreed that the earth should be a globe (nearly) Any flat map we make on paper (as opposed to one constructed on a ball) must represent a part or the whole of this globe As it is impossible to flatten a part or the whole of a globe without stretching tearing or compressing any map of any part or the whole of the globe must be distorted

We can control this distortion We can make our maps for instance fairly accurate as to the apparent outline of countries or lakes or of oceans When we look up and see the full moon it appears to our eyes as a flat bright disk with markings upon it If we actually draw these outlines on flat paper we have a map of the moon which is truthful in outline to what we see

But the distances as shown on our lunar map will not be truthful Such a map must show the center as distant from the rim of the moon an amount equal to half its diameter while the center is actually distant an amount equal to one-fourth the circumference. And what is true of the central point as compared to the rim is true of any other two points.

If we make an accurate outline map of North America so that the countries appear to the eye as they would to an observer on the moon the distances will not measure true And the closer to the rim of our circular map we get the greater the 'compression and the less the accuracy

There are a great many methods of making maps a great many different projections as they are called This name is used for the basis on which maps are made because projecting is the process Let us suppose a globe of glass with a tiny but strong light in its center On the outside of the globe of glass we draw with dark opaque paint, the land surface of the globe Let us suppose that we curl a sheet of white paper into a cylinder which fits close to the illuminated globe, in such a position that its sides are parallel to the axis drawn through the poles Upon the paper then, will appear a shadow of the countries we have painted on the glass globe If we now draw these shadows on the paper and then unroll the paper we have a cylindrical projection of the land contours of the earth In regions near the equator they are almost, if not quite accurate But as we look farther north or south, we find them more and more distorted And no matter how long our cylinder is it can never be long enough to get in *all* the map because as the line joining the poles is parallel to the sides of the cylinder, the polar land (if there is such) could never cast a shadow on the paper

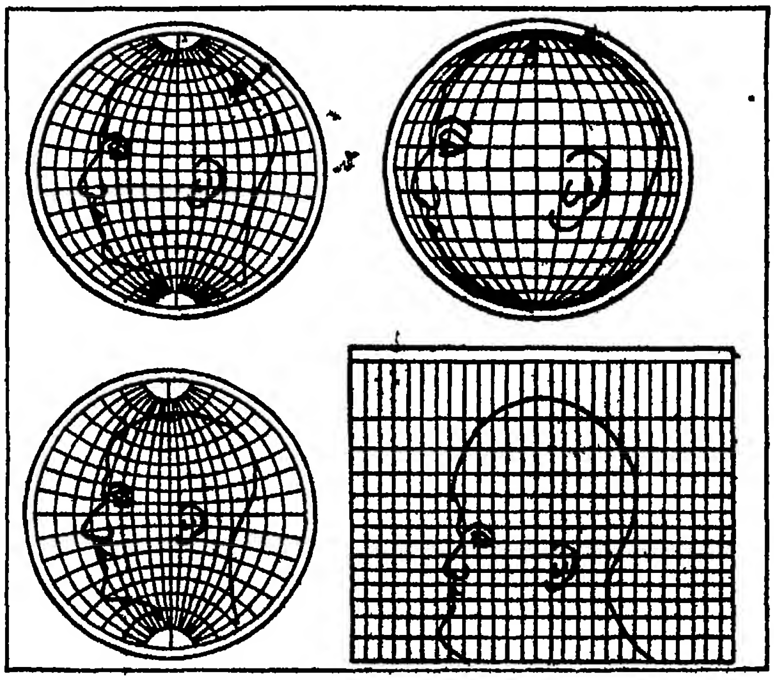
Such a projection is the base of the familiar Mercator projector which is in every atlas The Mercator projector is what is known as a 'conformal' one, the sketching of the polar regions is arbitrarily limited, usually to an amount not exceeding the 'stretching' east and west

But the Mercator projection is only one of many There are many different projections because of many different needs of maps for many different purposes. The ideal map, if it could be constructed, would show areas of true shape, areas would have perfect proportion to one another, as in nature, distances from place to place on the map would be truly proportioned to distances between the places on the earth, all great circles on the earth (a great circle is the shortest distance between any two points) would be straight lines on the map and latitudes and longitudes on the map would be the true latitudes and longitudes of the places on the earth

No flat map can give all these things in perfection. Many different projections give some of them correctly, the others distorted We select the requirement we need in a map, and construct our maps accordingly, Thus in the Mercator projection the great circle is a straight line The Mercator projection, then, is much used in sailing the seas because it is easy to plot a course on it It prevaricates badly as to distances, the mariner checks his actual position and distance of his run, by other means than visual examination of his Mercator projection

There are many different possible projections. We may consider the earth as a nearly globular body formed of small sections of the bases of cones. We can consider it as having a surface formed of small quadrangles. We can consider a 'stereographic" projection, in which our little light in the center of the sphere is moved to the south pole and projects shadows on a plane parallel to the equator We can make an "orthographic" projection, in which the projection point is infinitely distant—the moon map we drew in imagination early in this story is an "orthographic" one. We can make a 'globular' projection, in which the outer meridian and the central one are divided into equal parts by the parallels, which are arcs of circles. This is a much less misleading projection for common use in schools or homes, than is the Mercator projection. In other words it looks and "measures" much more nearly true to nature than the Mercator projection.

All this may appear somewhat difficult of understanding, but reference to the accompanying figures should make it very plain, particularly the four little drawings which show what happens in the



Upper left: Globular *Upper right:* Orthographic *Lower left:* Stereographic *Lower right:* Mercator

What four commonly used projections do, as shown on a human head

tention, when an area is pulled out of shape by one or another projection. Here is a man's head, drawn on a globular projection. If from this we make an orthographic projection, we spread him out, and make him fat and big and bulgy. If we use a stereographic projection, we do not alter his chin and neck and forehead and upper head so much, but we somewhat "mash in" his profile and his lower head. And what we do to him when we put him on a Mercator projection is frightful to behold. We strech him all out of shape

Yet the "latitude" and the "longitude" of every part of his face is the same on all four projections.

The reader is warned not to consider from this that the globular projection is any better or more accurate than any of the others. Had we at first drawn the head correctly on a Mercator projection and then transferred it to the others by comparing "latitude" and "longitude" of points on the face, we should have other and as drastic distortions.

Of course, for all small areas—a city, a county, half a state, even a whole state if it isn't too big—the flat map is sufficiently accurate in all ways for all practical purposes. One does not need a globe for short distances and small areas. But for large areas and great distances, no map is truthful in all ways, and he is the wise student and the well-informed reader, who either consults a globe when in need of accurate map information or uses his projection, whatever it may be, with a full consciousness of just how and where it distorts reality.

Rock Crystal Balls

By Herbert Whitlock

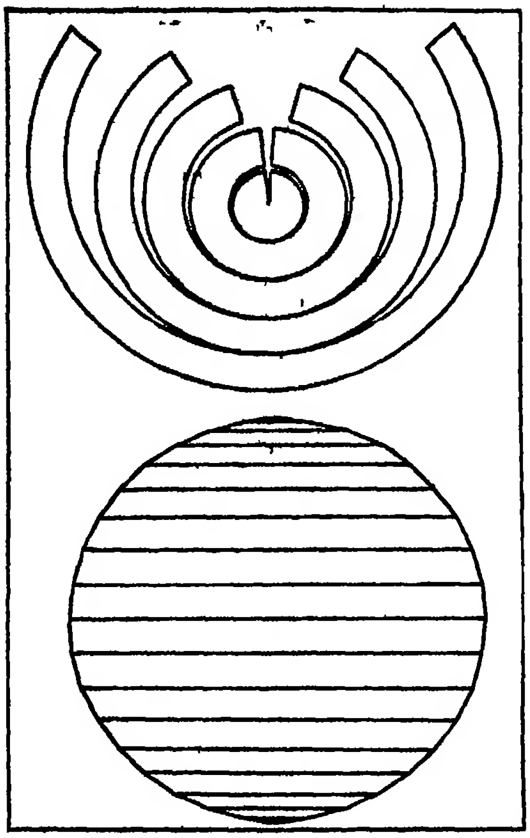
Curator of Mineralogy, American Museum of Natural History

AMONG the semiprecious stones there is none, with the exception of jade, which has been so extensively used as a material for carved objects as rock crystal. From Italy and France have come the graceful vases, chalices, bowls, and drinking vessels of classic beauty, of fine and rich ornamentation, from Russia art objects of more severe and geometric treatment, as well as exquisite statuettes and figurines in this limpid medium, and from the Orient the odd-shaped vases and snuff bottles characteristic of Chinese art.

Among all of these, however, there are probably no series of objects fashioned of rock crystal which are more striking than the spheres made by the lapidary artists of Japan The best of these are cut from flawless quartz crystals, clear and absolutely colorless, and are usually mounted on bronze wrought into decorative forms, such as dragons, storks, tortoise, and grotesque human figures. The clear, polished ball, contrasting with its dark bronze mounting, is preeminently an artistic object, lending itself with especial facility to the Japanese taste, which sets aside one beautiful thing as sufficient to contemplate and admire in an entire room. Groups of these balls delicately balanced in their mountings have been frequently employed in that land of earthquakes to give warning of shocks, effected by the slight preliminary tremors shaking them from their balanced poises.

Rock crystal spheres have, moreover, been since very acient times the especial stock in trade of the occult foreteller of events. Gazing into the still depths of these bits of earth's clearest substance, these seers of the future, so they tell us, can conjure up pictures impossible of production from commonplace glass. It is this alleged occult property which has raised the rock crystal sphere from a place of preeminent beauty to one of even higher romance and of unreality and woven around it an intricate web of legendary mysticism.

Dr. Dee, a crystal gazer of the seventeenth century, has handed down in his diary a very elaborate and complete description of the methods employed by occulists of that period, which are practically the same as those in use today. The crystal ball is supported upon a background of neutral tone, preferably black, in a room hung



If the earth were made up of a series of conical frustums, these would open out into plane sections to make a map

with similar draperies and lit only with candles or lamps which concentrate what little light there is present on the crystal The operator fixes his gaze upon the brilliant spot of light reflected from the polished surface of the crystal until consciousness of his surroundings is replaced by subconscious "vision." It is significant that, in all descriptions of these "visions," what we may call the critical period is marked by the fading away of the image of the ball itself from conscious sight and its replacement by a thin cloud or mist upon which the prophetic "images" appear

In a certain sense no less marvelous than the alleged occult powers of the crystal ball are the simple means employed by the Japanese artisans in producing them. This art, which, it is said, has been handed down from father to son for generations, consists of manual dexterity carried to a superlative degree Armed with only two primitive tools, the lapidary shapes from an angular quartz crystal a sphere of perfect roundness and high polish The quartz crystal is first roughly shaped to the form of a ball by chipping and abrading it with a piece of steel about twelve inches long and one-half inch wide, which has a concave cutting edge somewhat like a carpenter's gouge When by means of this treatment the mass has been made round and approximately smooth, a joint of bamboo is used to complete the polishing, quartz dust, which lodges in the pores of the bamboo and, finally, rouge, furnishing the abrasives

This all sounds extremely simple and no doubt is, to one who is trained to do it, but let the reader undertake it himself if he doubts the wonderful manual skill of these Orientals. Of course, in the lapidary shops of Europe and America where the grinding and polishing of crystal balls are undertaken, the lathe and the casting of just the right curvature for a ball of required diameter render the task infinitely more simple, but even with these aids the production of a rock crystal ball of a diameter of, say, three inches is a matter of weeks.

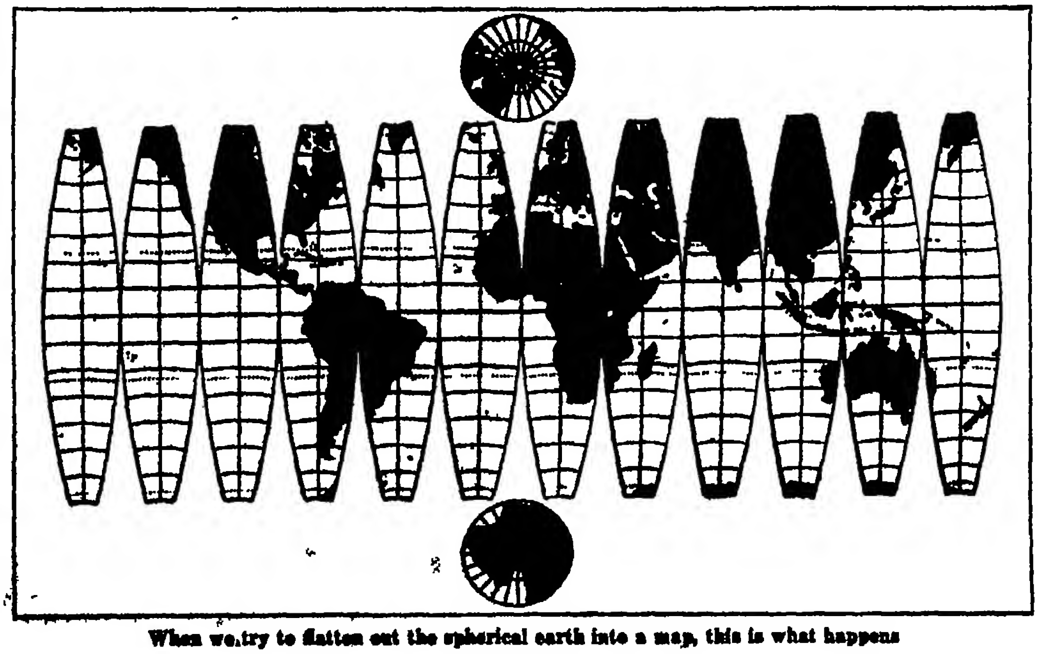
Inasmuch as the labor expended on a crystal ball of even modest size renders it a very costly object, continues the *Journal of the American Museum of Natural History*, the question which naturally presents itself is how can a purchaser be sure he is buying quartz and not glass? There are two very good ways of distinguishing quartz from its much more plebeian imitator In the first place, almost every piece of glass large enough for a ball of even small size is reasonably sure to contain one or more round bubbles. Although extremely minute, these may be detected with a good "loop" or hand lens. And inasmuch as quartz never contains round cavities, the presence of these latter will at once stamp the ball in which they are found as spurious.

There is, moreover, a much more exact test, which the writer has found to be applicable to balls from about one and one-half inches diameter up Quartz has the optical property, called double refraction of exhibiting two images of everything which is viewed through it in a certain direction It therefore becomes a very easy matter to apply the test by drawing a cross of fine lines on a piece of paper and then resting the ball on this cross and shifting it until a double image of the lines appears to the eye through the ball It is impossible for a glass ball to produce this effect. So we come at the end to an actual vision which any one can see by gazing into a rock crystal ball

Acetylene As Auto Motor Fuel

SWITZERLAND has turned to acetylene for use as a motor fuel, calcium carbide being a native product, while petroleum products are imported Acetylene, however, has not proved as satisfactory as gasoline, for when F Haber, a prominent German chemist, visited Switzerland in the fall of 1919, he did not find any cars running on acetylene, all having been reconverted to use liquid fuel Haber was engaged by the German Government to investigate the possibilities of acetylene as a motor fuel and he conducted a series of experiments. According to Keel, a Swiss authority on acetylene and its use 1 kg of acetylene gave as much energy as 2 kg or 2.5 kg of benzol, though the heats of combustion are only as 6 5. The reason for this Haber found to be that there is always an excess of air in the benzol fuel mixture, while acetylene can be burned with its theoretical air allowance. The combustion of benzol was shown to be incomplete, in tests that of acetylene proved to be complete

As regards the variation of the acetylene percentage in the air mixture, Keel stated that owing to the high pressures, and temperatures produced in the cylinder the advisable limits ranged from 1.5 per cent to 7.5 per cent of acetylene, Haber sets these limits at 3 per cent and 5 per cent. With mixtures deficient in acetylene, there was noisy back firing, with rich mixtures, pinking. The pinking is generally ascribed to spontaneous pre-ignition of the mixture by compression



When we try to flatten out the spherical earth into a map, this is what happens

A Wilderness Industry

How Gold Is Extracted Out of Ores on a Huge Scale in Order to Make It a Profitable Business

By Felix Eugene Averill

"A GOLD MINE" has ever been a phrase to intrigue the imagination and there are few of us but have at some time dreamed dreams of seeking fortune from hidden stores of the yellow metal in the depths of the earth or from the bed of some turbulent far-off stream. Even the highly efficient modern mining and milling operations on immense tonnages of low grade ores involving the prosaic methods of any up-to-date industry have not robbed the gold mine entirely of its lure for the imaginative adventurer, and when the mine is located in that part of the world which is known generally among the old timers as the "North Country" the call is irresistible.

But this is the story of the mine not of the miner. For even among those of us who have to be classed as parlor prospectors and adventurers and whose libraries are filled with stories of the romance of the North there are few indeed to whom the modern method of extracting gold from its ores is not considered in the light of a mysterious process to be understood only by the professional metallurgist or mining engineer. Among the general public there is probably no modern industry less understood. It is a fact of course that the details of the cyanide process of extraction involve many niceties of manipulation too involved for any but a trained metallurgist or mill man to understand. But in a general way the process is simple enough to be easily understood by anyone who is interested in learning something of this little-known industry.

There are two methods of mining ores that occur in large bodies as do all of the low grade ores in the district under consideration. One is the "glory hole" or open pit method and the other is the underground system of stoping. The glory hole, as a miner calls it, is an open pit where the ore is blasted out in much the same manner as in the more familiar stone quarry. The broken ore collects in the bottom of the pit from which it is drawn through chutes into cars in the underground workings which extend below the pits. The drillers using machines operated by compressed air work on the steep slopes of the pit wall and place the holes under the direction of the pit foreman in such a way as to obtain the maximum effect from the explosion of the dynamite. The drillers stop work and leave the pits at the same hour each day. As soon as the drilling stops the dynamite is brought into the pit and many times the foreman himself undertakes the work of placing the sticks in the holes prepared for them. Sometimes it takes a bit longer than planned to ignite all of the fuses, and he is compelled to seek what shelter he can from the flying rocks as the charges explode in rapid succession. When the first fuse is lighted a siren is sounded at the top of the pit, a warning which is universally heeded for there is no one so foolish as to neglect putting a safe distance between himself and the glory hole when the "shooting" begins. The shooting of the glory hole is a sight worth seeing—from a safe distance—for great geysers of rock and earth are thrown hundreds of feet into the air and a moment later the sky seems to rain stones.

The main artery of the underground workings is a vertical shaft through which the ore is brought to the surface and the miners are brought to and from their work in the various levels of the mine. Each level is a system of tunnels, or "drifts and crosscuts" extending from the vertical shaft. The drifts in each level are driven under the bodies of ore which lie between it and the level above. Chutes are driven from the drift up to the ore body and small inclined shafts, hardly large enough to crawl through, serve as means of communication between the "stope" and the drift and carry the compressed air pipes, by means of which the rock drills are operated.

The stope, after work has progressed for some time, is a huge underground cavern. The roof is of solid ore, the floor of ore broken from the roof above, by drilling and blasting away the rock and the extent and shape of its boundaries are defined by the ore body itself, the walls of the stope following exactly the boundaries of the ore. When the ore body has been exhausted, the stope becomes a large mass or pocket of broken ore which may then be drawn off through the chutes at the bottom into ore cars in the drifts of the level below.

The shaft itself is much like the familiar elevator of our cities. Like it, it is composed of several compartments, each of which has its car running up and down in the shaft. At the surface of the ground and astride the mouth of the shaft is a great steel structure—the headframe. In it is the hoisting and dumping mechanism and big steel ore bins into which the ore buckets dump their loads. Each car in the shaft is operated by a separate hoist and hoistman. An electric signal system installed at the hoist house and the stations at the various mine levels controls the operation of the cars.

The steel mill-bins are at the left, the belt conveyors which feed ore to the mills appear beneath. The tall tanks in the background are slime agitators

A ball-mill installation

A surface haulage system forms the connecting link between mine and mill carrying the ore from the headframe bins to the crushers where the ore is reduced to a size averaging about two-inch tubes. A conveyor belt brings the crushed ore to big storage bins in the mill building from which it is drawn off as required.

The essential steps in the milling or extraction process are these: Grinding the ore to a fine sand; recovery of coarse gold by amalgamation; extraction of fine gold by dissolution in potassium cyanide solution; precipitation of gold from solution and refining.

As just noted, there are two methods of recovery used in our mill, amalgamation and cyaniding. After the ore is crushed to a fine sand in the big steel ball mills enough water is added to form a fluid which may be pumped and carried in pipes and troughs to the various parts of the mill building. This fluid pulp is passed over copper sheets or amalgamation tables on which is a thin coating of mercury. The small particles of "free" gold in the pulp are caught and held by the mercury.

After all of the free gold has been recovered the sand is treated with potassium cyanide which dissolves the gold locked up in the tiny particles of sand. The latter has now become worthless "tailings" and is pumped away to the dump.

The gold is precipitated from the cyanide solution by the addition of powdered zinc. This precipitate, together with the amalgam scraped from the tables, is sent to the refinery at periods of a week or more.

The refining of the gold from the amalgam is very simple and consists merely in heating the amalgam in a closed retort until the mercury is vaporized and driven off. The gold when removed from the retort is in a spongy condition and is practically pure. This sponge gold goes immediately to the melting furnace, which is ready to receive it, and is melted down and poured into ingots ready for shipment.

The product of the cyanide process, the precipitate, is very impure when it comes from the mill. It is mixed with a suitable flux containing lead oxide and fed into a small blast furnace. Here the lead oxide is changed to metallic lead and filtering down through the furnace picks up the particles of gold in the precipitate and collects in a well at the bottom of the furnace. The impurities in the precipitate combine with the flux to form a fluid slag which floats on the top of the molten lead and is drawn off from time to time. Thus the material in the furnace is finally all reduced to the lead-gold mixture and slag.

The gold is separated from the lead by oxidizing the latter in a cupel furnace. The lead oxide is drawn off from the top of the molten metal as fast as it forms, until finally only the gold remains. The lead oxide thus formed is ground up and used again in the next batch of precipitate. The gold is broken out of the furnace hearth in a thin slab and melted down in the crucible melting furnace. It is then poured into bars.

There are usually two large bars from a run of precipitate and about the same quantity from a melt of amalgam gold. These bars will weigh over a hundred pounds each, although they are only slightly larger than a common brick. They are made in this heavy form to guard against the possibility of one being "slipped into the pocket" of some zealous "high-grader."

As soon as the gold bars are cooled they are thoroughly cleaned. They are then carefully weighed, after which each bar is stamped with its weight, number and name of the mining company. It is then sewed up in canvas and addressed to the United States mint, which is the destination of all the gold produced at this mine. Although the product of this mine refinery is practically pure metal, it is not fine enough for Uncle Sam's use, so it must again be refined at the mint. Here a small percentage of silver, together with traces of iron, copper and lead are removed.

The assay laboratory is a very important link in the chain of the mining and milling process. Through this medium a constant check is kept on the metal from the time of its discovery in the mine to its shipment to the mint. It is almost impossible, in fact, for any serious "leak" to occur anywhere in the process; for through the work of the assay office it is known almost to an ounce how much gold is taken from the ground, and this estimate must check very closely with the actual shipments of metal.

The gold value of the ore at many low grade mines averages not more than five or six dollars to the ton. When it is [illegible] [illegible] [illegible] amount of the mine [illegible]

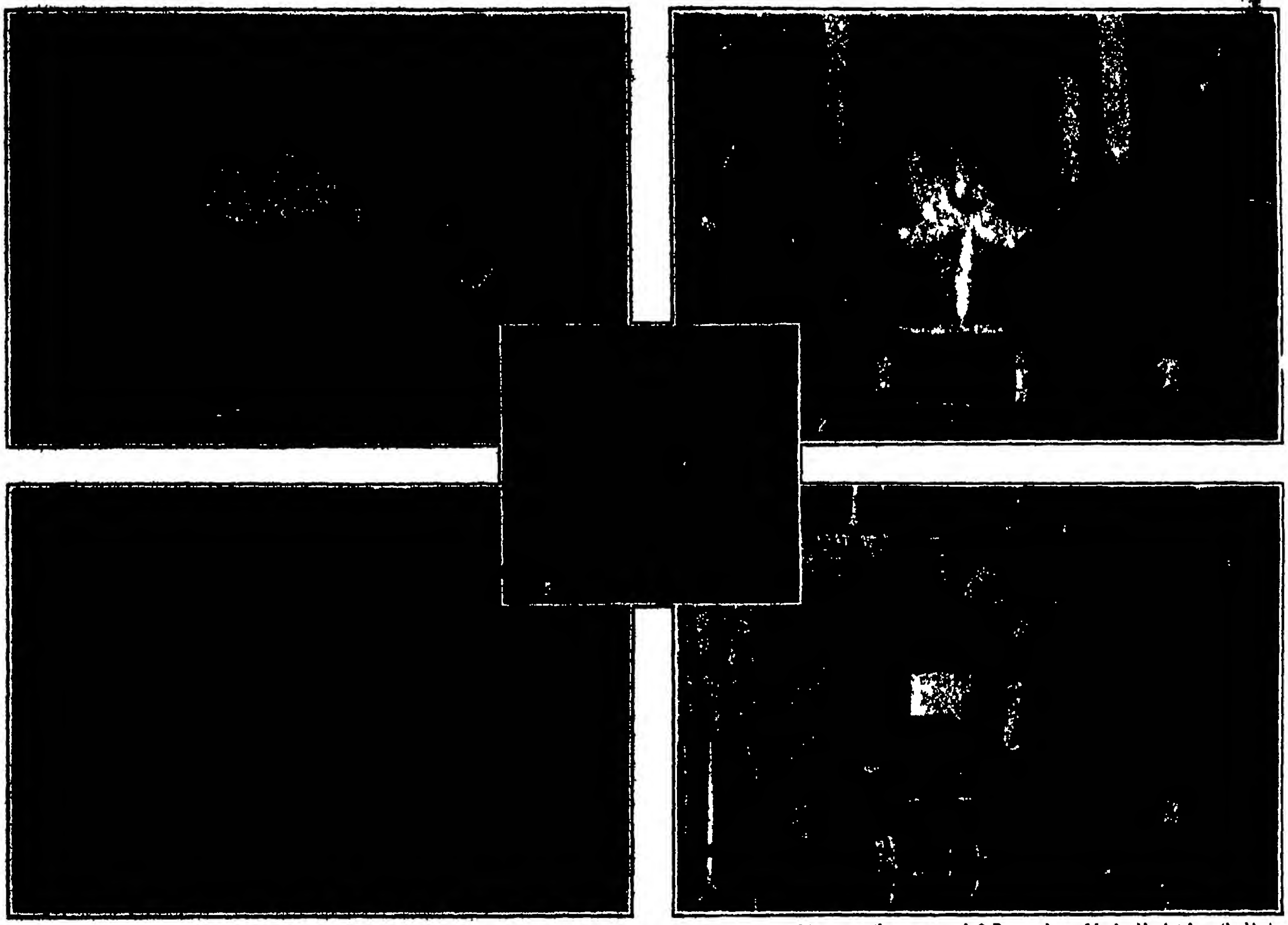
probable that the ore, which costs about the same to mine per ton, can be afterwards put through the expensive milling and refining process and yield a profit on the operation.

When our mine is operating at full capacity there are approximately one thousand men employed on the property. Of these, a large proportion are of the "floater" type, single men who find quarters in the company's bunk houses. The greater part of the mine officials live in houses built by the company on its own property. This group forms a little hamlet about the mine and has its company operated store and little red brick school house.

It is regrettable that social conditions, as in most small, isolated communities, are somewhat cramped. Educational facilities, too, are practically nil so that the mining camp does not usually appeal to the family man as an ideal place to live. These conditions do not mean so much to the single man, however. Of course there is a total lack of recreations such as are known to the city dweller but the fact that certain men do stick to the country year after year is proof enough that there are compensations for those that enjoy the life. Fishing, hunting, tramping and canoeing are ever available sports, and a prospecting trip two or three times a year fulfills the ambitions of many an old timer. The fact that they never become discouraged, no matter how poorly their samples may pan out, indicates that it is the life in the open rather than the prospect of a good find, that sends them off on the trail again and again.

It must not be supposed that the labors of these amateur prospectors are always fruitless. Many valuable properties have been and are constantly being discovered in this manner. There are thousands of square miles in Northern Canada that have never been prospected, and there is every reason to believe that there are rich rewards awaiting the enterprising and courageous prospector. A brief study of the map of Canada often proves a great surprise. We are most of us wont to think of our Northern country as typified by Toronto, Montreal or the Prairie Provinces. A glance at the map will show however that Canada as a whole is still a great wilderness into which civilization has penetrated only a few hundred miles or less along her Southern border. Beyond that are vast tracts of land where the trails of man would show only as tiny threads, penetrating the wilderness here and there at long intervals and finally dying out altogether.

To some of us the call comes clear and strong the call of the North to make our own tracks in that great wilderness. Our dreams are long beneath its spell. But not all can heed the call. Some must but dream. The chosen few will go.



1. Gas masks are used in the presence of the cloud of mercury vapor that issues from the retort when the la e s opened to remove the sponge go d 2 Pouring bars of lead gold a loy from the blast furnace. 3. A driller at work while his helper scales loose rock from the pit wall. 4. The final weighing before sh pment to the mint. 5 A tiny stream of molten litharge may be seen dr pping into the ladle

Steps in the ultra modern technique for making the gold ore give up its values

Keeping Growing Potatoes Cool

An Iowa potato investigator C L Fitch has determined with exactitude the effect on growing potatoes of varying degrees of heat. Not the potato bug nor any of the various potato diseases, is the most serious enemy of the potato Mr Fitch has found. The greatest enemy of the growing spud is heat. When soil temperature gets just about so high the potato grower can simply say farewell to a profitable crop. This temperature is a few degrees above 85.

So, "keep your potatoes cool, is exceptionally good advice to the grower. In fact, in all latitudes where spells of very hot weather are of fairly common occurrence, measures to protect the growing spuds against heat should be regularly practiced. Some of these begin at planting time others can be adopted in the emergency when it arises.

Deep and constant cultivation is probably the best measure the grower can adopt when abnormal heat begins to bake the soil. Mr Fitch recommends it. Stirring the earth to a good depth and doing it often keeps down the soil temperature.

In the well fertilized field potatoes stand heat better than on poor soil. This is because the tops grow to good size spread ut and shade the ground. The shade keeps the soil temperature down.

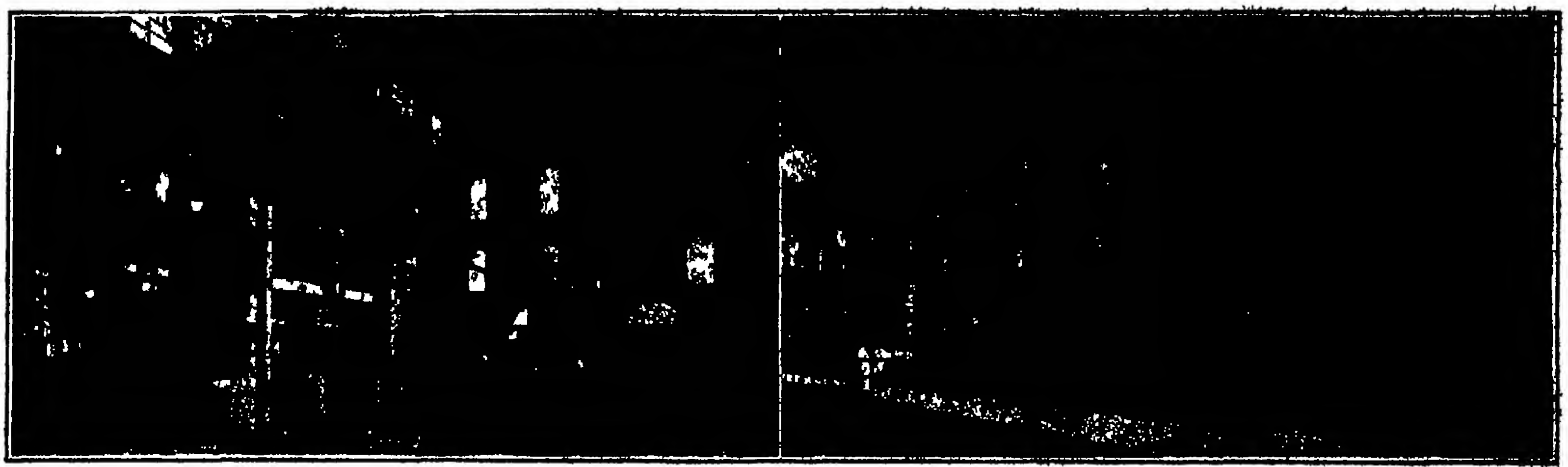
Using seed grown in a cool climate is a precaution. Potatoes from such seed are more resistant to heat than others.

The high temperature of a dry soil is not so harmful to potatoes as the equally high emperature of a waterlogged soil. This means that soaking a potato patch in very hot weather may be very dangerous.

These are the methods to protect potatoes against heat that Mr Fitch recommends. In localities where heat is a serious annual prol lem a field with a northern or eastern expos re would be more suitable if available than other exposures.

The p tato plant, Mr Fitch has found flourishes best at a soil temperature of 70 degrees. The seed will sprout and send up shoots at 50 degrees the plant will get along at 85 degrees of soil heat. A temperature of 90 degrees however is about the limit of safety.

Of course soil temperature and atmospheric temperature are two different things. S il temperature is much more constant. The tops of the potato plant can stand much greater heat than the roots—it s the roots the grower needs to care for.



Left: Bagging the sugar in a Cuban mill. *Right:* Eight big vacuum pans that extract the juice from the cane

Preparing the raw sugar for shipment to the refinery

The Story of Sugar

Where the World's Supply Comes From, and How It Is Converted from the Raw Material

By Arthur L. Dahl and Rozel Gotthold

SUGAR with its meteoric rise in price and its cataclysmic descent, has been a household word these four years past. Our bewilderment over the causes of 25 cent sugar and the impossibility of getting a supply at this or any other price was equaled only by our puzzlement when the bottom fell out of the market and we could suddenly have all we wanted of the universal sweetener. Many of the contributors to the Scientific American were moved, at one time or another during this period, to attempt the telling of the story of sugar. Mr. Gotthold and Mr. Dahl were the most successful of these. We have refrained from publishing what they or anybody else had to say of sugar until the lapse of time had given sufficient perspective to insure that nothing would creep into our columns that might later appear unjust or inspired by the abnormal conditions. Now that the time is ripe to tell the story of sugar we have decided to make this story even more conspicuously noteworthy by weaving the best elements of these two contributions into a single narrative, the one presented here.—THE EDITOR

THE adjective "sweetest" has long been appropriately applied to sugar, and not so long ago a new word—"dearest"—was crowding it for popularity. Sugar in one form or another is one of the most plentiful foods we have, for Nature distills sweetness in a large proportion of her vegetable plants, flowers and trees. The sugar of commerce, however, is obtained principally from two raw materials—the sugar cane and the sugar beet. Only three countries of the world produce both cane and beet sugar—the United States, Australia and Spain—for cane production is practically restricted to the tropics, while sugar beets are grown mainly in the temperate zone. One-fifth of the world's production of cane sugar comes from Cuba, another fifth from India and one-tenth from Java. Next in order of importance as producers of sugar of one sort or the other are Germany, Austria, Russia (in normal times), the United States, Hawaii, Porto Rico, Formosa, Australia, Peru and Mauritius. During the war one-third of the world's sugar producing area lay within the battle lines of Europe. The war has had the effect of largely increasing production in Cuba, Java and India, but Porto Rico, Hawaii, the Philippines and British West Indies show little increase, although all of these countries have been important sugar producing districts for a long time. In 1910 the world's production of cane and beet was equal. Now the ratio is about 70 per cent cane to 30 per cent beet. In Europe the production of France has been reduced to a fraction of its pre-war size and Belgium and the Central Powers are producing about half as much as formerly.

The United States is not the greatest consumer of sugar per capita, that distinction going to Australia with an individual consumption of over 100 pounds per annum, but at the rate we are increasing our consumption we shall soon outstrip Australia. In 1919 we used over four million tons of sugar in the United States, or 16 per cent more than the year previous. This amounted to over 92 pounds per capita, as against 85 pounds in 1918, 84 pounds in 1914, 79 in 1917 and 78 pounds in 1918.

The United States is dependent upon outside sources for over three-fourths of its sugar supply. While cane sugar is grown in a small area in the extreme southern part of our country, principally Louisiana, our domestic supply of cane sugar represents less than 4 per cent of our consumption, and would last us but 14 days each year. From our domestic crop of sugar beets we obtain a larger quantity of sugar, and the supply from this source would fill our wants for 78 days out of a year. Cuba supplies us with more sugar than any other country, sending us almost 51 per cent of our consumption. We secure almost 18 per cent from Hawaii, 7 per cent from Porto Rico, not quite 2 per cent from the Philippines, and a little over 2 per cent from outside miscellaneous sources. The following table shows the source of the sugar used in the United States in 1919:

United States beet	872 258 tons
Louisiana and Texas cane	154 084 tons
Hawaii cane	514 824 tons
St. Croix cane	8,286 tons
Porto Rico cane	286 880 tons
Philippine cane	72 511 tons
Cuba cane	2 067 061 tons
Maple sugar and molasses	34 094 tons
Miscellaneous foreign	57 798 tons
Total	4 067 671 tons

The oldest source of our domestic sugar is a section of Louisiana east of the Mississippi River and extending to the Gulf coast, and thereby hangs a tale. In 1776 the cultivation of sugar cane was actually given up in Louisiana as unsuited to the climate. But in 1795 Etienne de Boré made a crop of sugar which netted him $12,000, a large sum of money in those days. Until 1794 he was a planter of indigo, which was the important crop of the period in Louisiana. But the losses from hurricanes and the ravages of insects were tremendous, so that Boré looked about him for something else to plant. There were two Spaniards in New Orleans planting considerable cane, but they had never got sugar from it: one of them boiled the juice into syrup and the other distilled it into a poor quality of liquor. Boré bought some canes from these men, which later gave him his fortune.

It is interesting to read of the sugar-making in Gayarré's History of Louisiana. "On the day when the grinding of the cane was to begin, a large number of the most respectable inhabitants had gathered in and about the sugar-house to be present at the failure or success of the experiment. Would the syrup granulate? Would it be converted into sugar? The crowd waited with eager impatience for the moment when the man who watches the treatment of the juice determines whether it is ready to granulate. When that moment arrived the stillness of death came among them, each one holding his breath, and feeling that it was a matter of ruin or prosperity for them all. Suddenly the sugar maker cried out with exultation, 'It granulates!' and the crowd repeated, 'It granulates!'"

Outside of this Louisiana region cane is grown generally throughout the Gulf States, but there it is used almost exclusively to make syrup and not sugar. Practically the only other cane sugar from our Southern States is made in a few scattered localities in Texas. Sugar cane requires a long growing season to mature fully, and the prevalence of frosts in most sections of the country precludes the extension of the growing areas beyond the present limits, except possibly in Florida, where successful plantations have been made.

The center of the cane industry in the South is in the parishes of St. Mary, Lafourche and Terrebonne, in Louisiana, where cane occupies 42 per cent of the improved land. These three parishes, in fact, grow about 40 per cent of the total crop of sugar in the South. They also contain 51 of the State's 150 operating factories for the crushing of cane. One of the characteristics of the Louisiana sugar industry is its uncertainty. Cane does not mature there, for the growing season is too short. Cane is harvested before it is fully ripe and the cutting season is limited to the several weeks between the middle part of October and the coming of the winter frosts. Working immature cane results in a lighter tonnage per acre than is obtained in Cuba or other tropical countries, where the cane is allowed to grow from 12 to 18 months, and it also results in a smaller sugar content in Louisiana than in the tropics. As an evidence of the fluctuation of the cane production in Louisiana, due to climatic conditions, we find that in 1904 the State produced a record quantity of 398,195 tons, while in 1919 the total production of cane in Louisiana and Texas combined was only 154,084 tons. The difference is wholly due to unseasonable weather.

Of our island possessions, Hawaii is the greatest source of our sugar supply. The principal industry in the Hawaiian Islands is the growing of sugar cane and the manufacture of raw sugar. It has the most highly developed organization for sugar production found anywhere, and about one-fourth of the entire population of the islands is engaged in this industry. There are some 53 mills, practically all of which are large or medium sized, the annual production of a mill ranging from about 4 million to 100 million pounds. The season in Hawaii is long, beginning nominally about October 1st and continuing for a large part of the following 12 months. Nearly all of the crop consists of raw sugar which is shipped for refining to San Francisco and to Atlantic refineries. There are about 230,000 acres devoted to growing cane in the Hawaiian Islands, and owing to the long growing season only about half of the growing acreage is cut each year. In the same field

one may see planting and harvesting operations going on side by side, as the land is prepared for a new crop just as soon as the mature cane is removed. The yield of cane is heavy in these islands, ranging from 39 tons per acre to 46 tons in a good year, and the cane is high in sugar content, yielding an average of 245 pounds of sugar per ton of cane.

Nearly all cane is grown under irrigation in Hawaii, and in the development of the water resources of the islands the sugar planters have earned the reputation of being the most daring and successful land reclaimers in the world. The rainfall in the islands varies to a marked degree in areas not far apart, owing to wind conditions and the location of high mountains. In some sections the rainfall is too excessive to permit of cultivation, while in others it is deficient. The sugar planters, therefore, have constructed immense irrigating reservoirs and canals, often taking the water from one side of a mountain and conveying it through miles of tunnels to where it is needed. Two of the oldest plantations, Koloa and Lehue, have jointly over 40 miles of tunnels which tap the mountain streams. They also have a system of 9 storage reservoirs with a capacity of over 75 million gallons every 24 hours. Twenty-four plantations in the Hawaiian Islands have an investment of over \$13,000,000 in reservoirs, pumping stations and equipment, pipe lines, ditches and irrigating flumes, and 14 of the sugar companies own 97,000 acres of forest land, maintained solely for the development of water. The Oahu plantation with a cane acreage of only 8550 acres, has spent almost \$3,000,000 in the construction of the great Waiahole Aqueduct, which required more than three years to build. This aqueduct is 14 miles in length and includes 10 miles of tunnel, 3¼ miles of concrete-lined ditches, and 1⅛ miles of steel syphon pipes. The main tunnel is 14,448 feet in length, piercing the Koolau mountain range. The mills for crushing the sugar cane in Hawaii are the most modern in the world, and machinery is used wherever possible. While considerable fuel is required to operate the crushing plants, practically all of this is secured from the refuse, or bagasse, left after pressing out the juice from the cane.

Sugar has been the principal crop grown in Cuba since its early days, and over half of the cultivated area of the country is devoted to cane. Climatic and soil conditions are favorable for its growth, and the cane is allowed to stand for 12 to 18 months before cutting. It is only necessary to replant the cane fields every 4 to 7 years in the older sugar districts and from 10 to 12 years in the new ones, as most of the production is from "ratoon" crops which spring up from the root systems and stalks left in the ground after harvesting the mature cane. A higher production is obtained from what is called the "plant cane crop," but on account of the saving of labor, the ratoon system is largely in vogue. The cane crop is harvested more or less throughout the year, but the principal harvest season is from December to June. Over a million and a third acres are devoted to cane production in Cuba, and there are 176 factories in operation, grinding the annual production of 15 million tons or more of cane. The sugar plantations are equipped with private railway lines to transport the cane to the factory, and altogether there are over [illegible] miles of such roads, using 15,161 cars and 485 locomotives. The daily grinding capacity of all the factories is about [illegible] tons of cane, and the sugar content of the cane averages from 11 to 15 per cent of the weight of the cane.

36 x 84-inch roller mill with fifteen rollers, and 36 x 87 double crusher, all driven by three engines

The sugar factories of Cuba have made considerable improvement in the use of modern equipment during the last few years, and the United States manufactures and installs most of this machinery. One factory in St. Louis is said to supply a large proportion of the sugar-making machinery used in the cane districts of Cuba and Porto Rico, and American machinery is fast supplanting the primitive and inefficient methods used in the earlier grinding mills.

Porto Rico is also an important producer of sugar cane, and there are 65 establishments for making sugar. In normal times Porto Rico supplied the United States with something over 700 million pounds of raw sugar per annum, but during the war her production was greatly stimulated and her annual crop now exceeds a billion pounds, practically all of which comes to this country. There are 208,000 acres of land devoted to the growing of sugar cane. Some of the large grinding mills, or "Centrals" have a capacity of over 40 million pounds of raw sugar each season, and United States manufacturers build most of the modern machinery for the sugar mills.

While sugar is classed as one of the leading industries of the Philippines, with an annual production up to a billion pounds, only a part of the raw sugar is sent to the United States, as nearer markets lie in China and Japan. The methods of handling sugar in the islands are still somewhat primitive and most of the cane is handled in small mills operated by the natives.

The British West Indies hold third place in sugar production from British possessions. The island of Trinidad is the center of the cane industry, and in some of the adjoining islands much of the cane is used for the manufacture of "fancy molasses" which is largely sold in Europe.

Sugar cane is also grown, more or less extensively, in Mexico, Costa Rica, British Honduras, Argentina, Brazil and the other countries of Central and South America, where climatic conditions are favorable. India grows an enormous quantity of sugar cane, but practically all of it is needed to feed the millions of people within its own boundaries. Australia and New Zealand also grow sugar cane, but the production is not sufficient for domestic needs and little of it is exported. The Island of Java, in the Dutch East Indies, devotes 405,000 acres to the growing of sugar, and a high yield is obtained from the cane grown there, being exceeded in sugar content only by Hawaii. A large part of the Java production is exported, but little comes to the United States except in times of great scarcity, or when prices are high. We got a good deal of Java sugar in 1919 and early 1920. One shipload of East Indies sugar arrived in San Francisco for the use of fruit canners, who had found it cheaper to purchase this oriental supply than pay the prevailing prices in the United States.

The method of handling cane is very much the same in all countries. When mature, the cane is cut by hand and conveyed to the crusher by railroad, flume, or ox cart. The modern sugar mills are equipped with a series of iron rollers through which the cane passes, and the juice is squeezed out and conveyed to tanks while the dry pulp passes on and is used for fuel. The cane juice, in addition to the sugar in solution, contains glucose, other non-crystallizing sugars, fats, waxes, gums, nitrogenous substances and a small amount of acid. In the mill the juice is boiled in vacuum tanks to extract the 74 per cent of water it contains, and the remaining substances are treated in different ways to separate the various constituents, until finally a crystallized raw sugar is obtained, which is put up into sacks and sent to this country or to England for refining.

This sounds simple enough, but sugar making today is not so elementary a matter as it was for Boré. He and his friends would have a real thrill if they were to be taken into a sugar factory, to see the crushers and mills, the filtering, the evaporation, the crystallization of sugar in those interesting machines.

The mills used are three 3-roller mills, set tandem. They are driven by one engine, and are geared at one side. Each mill has a headstock, of solid heavy casting, bolted through to the lower plate by two king bolts. There is a top roller, with two others underneath it. In the center of each mill is a trash turner which sends the bagasse, or partially crushed cane, from the top to the last roller of the mill. The rollers are grooved, and experiments are constantly being carried forward to deepen the grooves, the newest rollers having grooved surfaces to the depth of three-quarters of an inch, which facilitates the crushing. The cane is prepared for the mill by crushers, the type most in use is composed of two rollers, having surfaces with great V-shaped grooves. The rollers may be set either to crush the cane or to cut it into small pieces. From the mill, the juice rolls down into the trough underneath it, and thence to a tank, for sulfuring. The bagasse is sent to the bagasse burners, for fuel.

In the making of direct consumption sugars, the juice is treated by using sulfur dioxide, which bleaches it, and lime, which settles it. At the Audubon Park Experiment Station, conducted by the Louisiana State University, there has been carried

A big cooling tower in one of the Cuban mills

out a very interesting experiment in clarification of cane juice with diatomaceous earth and decolorizing carbon The diat ma eous earth used is found in quantity in Calif rr ia It has been used for filtration purposes in t l t best sugar factories of Europe since 1886 A t n f it with freight charges from California c sts in L uisiana about thirty five dollars The vegetable carbon used for dec lorising the juice comes from Holland and that is about all that is known of it here

For this experiment the juice from the mill instead of being sulfured was put into the clarifier where it was treated with one-half per cent of filtering earth then the entire contents were run through the filter press, into the sec nd clarifier and then treated with one per cent of the decolorizer The result of this method of clarif ing was that they g t at least as much sugar as the yield by sulfitati n that the raw sugar obtained has the c lor f yellow larified without washing in the centrifugal that it contains less non sugars than that obtained by the sulfitation process that the expense attached to its use will in all likelihood be considerably lessened by the sale of the improved grade of molasses which results an l which is expected to sell on the New Orleans Exchange for 65 cents per gallon—an excellent price

To appreciate the importance of this new clarification one must understand the system which has heretofore been used The sulfured juice is sent to the clarifier where it is brou ht t the b iling point This causes the heavier particles of dirt to fall to the bottom the lighter scum t rise to the surface of the liquid Between the tw is the la er of clear juice The bottom of the clarifier is opened the mud falling into the mud tank When the juice comes clear the clarifier is closed and the juice is run off into the settling tanks. When the layer of aerated scums begins to be drawn off the valve is cl sed and the scums are run off through the filter press All of this part of sugar making theref re is eliminated by the new process, which saves a great am unt of time and lab r as is to be seen the entire contents of the clarifier containing juice and filter being run through the filter press at once treated with decoloriser and run through again For in the actual filtering the filtering agent which is composed of articles of silica rapidly takes on the particles of s um to form a cake which particles without such aid would have clogged up the cloth of the filter bags, making the process of filtering slower and more tedi us because f frequent changing of the bags

The filter press used is a frame-and plate press composed of hollow frame and solid plate placed alternately in the press Each of these has two openings in it, in the angles which form two channels running through the press Each also has a cock to let the clear juice out The bags are laced over the solid plates and the scums f rced through the press in such a way that the cake is formed of them between the bags when the juices are pressed out Then water is forced through the cake to wash it of the remaining sugar

The cake contains 69 7 water some sugar glucose wax albumen fiber or anic acids, gums sand clay It is used for fertiliser

The juice is next sent to t e evaporators where it is boiled into syrup A considerable difference exists between the intricate system of effects and the earliest met od of eva ratic n in ts over an open fire The latest word is a triple-effect evaporator equipped with special interceptor to catch splashing sugar bubbles and return them to the vessel Instead of a horizontal system of tubing the evaporator is equipped with vertical tu es attached to two tube plates forming a steam chamber This is filled with steam all ar und and above the tubes. Juice is turned into the vessels from the tank until it is a little above the tube system The vacuum pump is started and a vacuum of twenty five inches obtained in the last effect The water injection cock is opened and steam is admitted t t e first evaporator This begins to boil the juice and the vapor rises and flows through the vapor pi e i t the second body of the effect which has already been filled with juice a little above the tube system Th tubes condense the vapor and the juice boils. This pr ce is repeated in the third body etc.

The juice leaves the effect in the form of thick syrup. It is drawn upward into the vacuum pans, in which occurs the real art of sugar making The vacuum pan has virtually the same form as the effects. Instead of the steam chamber h wever it is fitted with a system of steam coils, eac having its valve A vacuum is obtained as before, and the syrup is distributed evenly through the pan The idea is first to grain the sugar and here the man at the post takes samples of the syrup by pulling out a wooden plug at the side of the pan having grooves in which he obtains a small amount of sugar He tests this and when the grain is obtained, he feeds the pan with fresh [illegible] of syrup in order to make the sugar crystals [illegible] begin to separate and fasten on to the grain [illegible] formed. If a new crop of grain is made, it is called "false grain or dust and is not wanted, as it will be lost in the centrifugal. But to get an even crystallization, the pan must be evenly boiled, and the temperature must not be changed

If a large-grain sugar is required, a small quantity of syrup is granulated at a time. This is called "graining low down." If a small-crystal sugar is wanted, large charges of syrup are put into the pan This is called "graining high up.

How long to boil a pan in order to "make a strike," is a matter of the purity of the juice, the size of the pan etc. With very pure juice, boiling may be continued four or five times. With impure juices, two sugars are as much as may be obtained

The contents of the vacuum pan, called "masse-cuite" consist of sugar and molasses. They are taken to the centrifugal, which is a perforated basket, cylindrical in shape, having a strainer of fine wire gauze. The centrifugal is made to revolve at a high speed, throwing the masse-cuite violently against it. The strainer retains the crystals, the molasses passing through it into a space outside of the strainer whence it flows along a gutter into tanks The first molasses is boiled back and as said before if the juice is very pure, three and four sugars may be obtained The sugar in the centrifugal must be washed when white sugar is required then dried under high pressure steam.

Sometimes, on the plantation, crystallisers are used when a large quantity of small grain sugars may be made of juices not so pure These vessels are fitted with paddles which stir the masse-cuite constantly, cooling it, thus crystallizing it.

There are 22 cane sugar refineries in the United States with an estimated maximum capacity of daily meltings of 40 million pounds In these refineries the raw sugars from Hawaii Cuba and other countries are refined and made into the granulated and cube sugars of commerce The by products of the refineries are made into molasses for human consumption or into stock food

C ntrary to popular belief there is no chemical difference between refined sugar made from cane and beets The grains made from cane raws may be slightly finer in texture than the beet sugar but one is just as sweet and good as the other. This is true of the beet sugar made in the United States, though the beet factories of Europe have not yet succeeded in turning out as fine a grade of refined sugar from beets as we have, and much of the prejudice against beet sugar is caused by the a pearance of the imported article

If the United States had to supply all her own sugar she could do it only by increasing the area planted to sugar beets, and it is entirely feasible to enlarge greatly our production from this source In 1919 there were 692 455 acres of land devoted to the growing of sugar beets in the United States, and we produced 726 451 tons of refined sugar from this acreage Although this was the largest area sown to beets in our history the production was disappointing due to adverse climatic and other conditions Not only was the production of beets per acre lower than normal but the sugar content of the beets was likewise below the average At that the beet growers were paid $75 4 0 000 for their crop Generally speaking, it takes eight tons of beets to make one ton of sugar but the refuse in the form of beet tops and beet pulp, is used for stock feed or fertilizer

There are 99 sugar beet mills in the United States, most of which are located in the States of California, Colorado and Michigan, which three States produce three-fourths of our total crop of beet sugar The industry however, has assumed important proportions in some of the Lake States, such as Illinois, Iowa, Minnesota New York, Ohio and Wisconsin and in the North west, including Washington, Oregon, Idaho, Utah, and Montana. Both cane and beet sugar is produced in Arizona, though not in large quantities.

The season for harvesting beets and making sugar begins in California late in July or early in August, and Utah, Colorado and States farther east late in September or early in October The sugar campaign is usually over by January, but may continue until March. The beets are sometimes kept until time for [illegible] by siloing them which means that they are put in piles with sufficient earth thrown over them to protect them from frost The average production of sugar [illegible] per acre is around 9 or 10 tons, and the growers are paid by weight, with a sliding scale based on the sugar content of the beets In 1919 the average price paid for sugar beets to the growers was $11 75 per ton, as against $10 per ton in 1918.

The process for making sugar from beets is entirely [illegible]

[illegible] adequate supply for the mill.

The Self-Supporting College

A TECHNICAL school which will be self-supporting, with a student body also self-supporting, is the promise of a plan for reorganizing Antioch College fostered by Arthur E. Morgan widely known engineer Mr. Morgan is just bringing to completion for the City of Dayton a $50,000,000 flood prevention project, the greatest of its kind, and is soon to undertake a similar scheme for Pueblo Col He has become President of Antioch College, near Dayton, and will direct his industrial enterprises from there.

Associated with Mr Morgan in his unusual educational undertaking are a number of engineers, bankers, lawyers, farmers and manufacturers, some of national and all of at least local prominence These even form the Board of Trustees and they have largely furnished the money to launch the enterprise, with the expectation that it will be independent of endowment within a few years.

Following the example of Mr Morgan, both faculty and students are expected to engage in actual commercial enterprises, part of the proceeds of which will go to the college. It is the plan to engage as instructors the best men in their respective fields. A small college ordinarily could not afford to pay the salaries of these men. But under the Antioch plan they will get a salary of slightly less than they have received in the commercial field Each department head will be expected to work up a consulting business. In this he will be financed by the school and his plant and equipment furnished As far as possible his assistants and students will constitute his working force Half of the proceeds of such enterprise he will retain and half will go to the college.

Most of the students will spend alternate periods of five weeks at school and in a nearby commercial institution where they will be employed along the lines f their studies. There is now being erected on the college campus a commercial machine shop, where small articles will be manufactured and repair work done. This will be conducted as a commercial venture by students, who will be responsible for profit or loss. A dairy farm soon will be opened under the same plan. Other industries will be added later including a publishing plant.

Education has always been a hobby of mine," said Mr Morgan, in a recent interview with the writer, and I determined that if ever the opportunity came I would try to fill what seems to me to be a big need. The average college graduate either has acquired a classical education with no preparation for entering business or he has become a highly trained technician, to the neglect of the broadening influences of general study

"It will be the aim of this institution to turn out, not the classical scholar or the highly trained technician but a man or a woman who is enough of each, and who at the same time has enough practical experience to take up an independent place in life. We intend to help a student, through our courses, to find his proper place in life and to give him or her the broad foundation that every person ought to have before he or she takes a highly specialized technical course.

We expect to derive from our plan two highly important results. First, by being free from the necessity of constantly seeking endowment, we make ourselves free to work out our own destiny in our own way The man who gives money to a college, you know, usually wants to know how it is to be spent. We do not want [illegible] tied to us. Secondly, we will be able to [illegible], and one of the finest things we have to offer is the intimate contact of the student body with the [illegible].

"We intend [illegible] to remain a small college [illegible] [illegible] in American education."

Anatomical Artistry

GUSTAVE VAN BOUCHAUTE, a quaint Belgian, holds an unusual position in the artistic world. At one time a plasterer and sculptor, he has turned his art into a useful channel. He is employed at Bellevue Hospital, N. Y., where he models all parts of the human anatomy and paints them in exact colors for students who are learning medicine and surgery. His models, say the authorities, will soon be used all over the world as they are now in New York hospitals and eastern Universities. The models, which are of stucco, are made in the following manner. A plaster cast of the organ is made after it has been well smeared with formalin. Into this mold is placed a composition of plaster, cloth and glue which is light and easy to work. When this composition is taken out of the mold it must be painted the exact color of the human gland, bone or muscle it represents. The molds are as accurate as the body itself.

Making anatomical models with plaster and brush

Moss Scrubber for Irrigation Projects

SPEEDING the flow of water in the irrigation projects of the West is promised through the use of a scrubber for cleaning semicircular flumes, a device recently designed and perfected by Charles B. Schmidt, manager of the Selah-Moxee irrigation district, in the Yakima Valley, Washington. The moss and silt that accumulate on the interior of the flumes are removed by this tireless mechanical arrangement.

A series of stout-bristled scrub brushes is fashioned in a semi-circle to the base end of a triangular frame which is supported at the apex by a small wheel. The scrubber is placed in the flume at the head end, with the brushes "rubbing elbows" with the sides of the conduit. The wheel, at the front end of the frame, rests on the floor of the flume. The velocity of the water is of sufficient progressive action to keep the scrubber in motion while the wheel guides and keeps the device from wedging. A heavy iron chain secures the tireless worker in place and forces the brushes against the sides of the flume.

The cleaning operation may be repeated if a single application of the scrubber does not suffice. Of course, the swiftness of the stream in many of the projects is such as to discourage the growth of moss and the accumulation of silt. However, when the current is tempered in its rate of progress this novel device is an efficient agent for the cleaning of conduit.—*By S. R. Winters.*

This curious collection of brushes scrubs the moss off the banks and bottom of the ditch

How More Light Speeds Up Vision

THE talking machine has found a new use! Did you ever try to read the name of a record as the record went around and around on the machine? Of course you have—and you probably could have done it successfully if there had been plenty of light.

Some able illuminating engineers not so long ago decided to construct a simple apparatus by which they could demonstrate to anyone the fact that good light enables the eye to see faster.

A cylinder in diameter the size of a phonograph record and about 15 inches high was built, and on the surface of this roll or cylinder, letters and figures of various sizes were pasted. These letters were placed in no particular order and when they [illegible] the whole thing [illegible] like an optician's [illegible] only cylindrical [illegible] of flat. [illegible] cylinder was [illegible] on a phonograph [illegible] the machine was started the cylinder of course revolved. To cover the front of this another hollow halfcylinder was made but this one had a slot about 2 inches wide along its entire length. When the half cylinder was placed over the revolving one only that part of the moving surface directly behind the slit was visible.

Thus, different letters of alphabet and figures, etc., moved past the opening and it was the duty of those observing the apparatus to find out which letters they could read. In other words at the speed at which the machine was then moving to find out which was the smallest size of figures or letters that could be recognized.

During the first experiment the lighting of the room was that ordinarily found in the workshop or office perhaps four or five units. After all were satisfied that none of the smaller letters or figures could be distinguished additional light was thrown on. Sufficient lamps being used to raise the intensity of the light from four units to over twenty units.

To the surprise of each observer the smaller undistinguishable revolving figures immediately took definite recognizable shape while the speed of the machine actually seemed to slow down. Of course there was no change in speed since nothing on the machine was touched, the only change was the increase in illumination.

The human eye is perhaps the most delicate and precious gift that man has and yet people day after day year by year constantly impair its efficiency by making it work under conditions that are not of the best. If, as the demonstration showed, the eye can see more quickly under light of high intensity, is it not reasonable to suppose that the eye can do a certain amount of work with much more ease when the work is properly illuminated? Make sure that you have sufficient light, whether you are using a machine in the factory or reading a magazine at home.—*By Freeman Barnes.*

The lettered cylinder (center), the outer shell (left), and the manner in which they are assembled on a rotating base to test the bearing of increased illumination upon rapidity of vision

Muscle

IN the *British Journal of Physiology* for August, 1921, Dr. D. Adrian, of Trinity College, Cambridge, presents in a paper of some length the results of investigations on *the recovery process of excitable tissues*. The chief conclusions which Dr. Adrian reaches are that in the frog's medullated nerve the absolute refractory period does not come to an end until the electric response has almost subsided. The gradual return of excitability takes place after the tissue has regained its normal potential. This holds good over a wide range of temperature. In the sartorius muscle the return of excitability comes on much more rapidly. At room temperature the absolute refractory period corresponds to the rising phase of the electric response and the relative refractory period to its decline. At low temperature this relation is disturbed and the return of excitability takes place more slowly than the decline of the electric response. In cardiac muscle at room temperature the return of excitability does not begin until just before or just after the complete disappearance of the electric response and there is evidence to show that in abnormal conditions it may be still further delayed. Incidentally the monophasic electrocardiogram shows no signs of being made up of two components. An initial spike is observed only when the response has become diphasic. The supernormal phase of recovery which takes place in a tissue perfused with an acid solution is not associated with any prolongation of the electric response either as a positive or negative after-effect. An electric response set up during the supernormal phase of recovery in the heart is no greater than the normal although the accompanying contraction is increased. Thus the return of excitability does not necessarily occur at the same time as the decline of the electric response. The relation between the two processes varies from one tissue to another and in connection with any given muscle from one temperature to another. There is often no difference of potential between a surface which is recovering from the results of excitation and one which is at rest.

These results, it is important to note, can be explained satisfactorily on the membrane theory by means of the scheme put forward by Lillie. According to this scheme the decline of the electric response is caused by a reduction in the permeability of the surface membrane and the return of excitability is due to a return of the membrane from a stable to a more unstable condition. It now appears more than ever probable that this is correct

A Climax in Concrete Construction

Erecting An Eighteen Story Reinforced Concrete Building at a Lower Cost Than a Structural Steel Type

By Robert G. Skerrett

Expanded metal wired to fabricated steel reinforcement, preparatory to setting the metal work in a vertical position for the casting of the concrete side-walls

THERE is a section of Manhattan Island near the western end of Brooklyn Bridge which is popularly known as the Swamp. At this point the overburden is made up of strata of fine and coarse sand underlying layers of muck and peat, and this alluvial deposit covers the buried rock to a depth of 100 feet. This ground naturally presents somewhat of a problem in erecting and supporting in a satisfactory fashion a modern towering business structure. And yet despite the physical condition there has been recently reared within this area a massive 18-story reinforced concrete building.

This skyscraper is the tallest edifice of its kind in existence, and in its construction a number of novel methods were employed both to expedite execution and to insure the strength and stability required to meet the special service for which the building was designed. To be exact, the structure is in the heart of the hide and leather district of New York City and is intended to answer conjointly for loft and office purposes. From the very nature of the goods to be accommodated it was necessary that the floor should be sturdy enough to sustain unit loads up to 200 pounds per square foot. And let it be remarked here that the cost of the undertaking was less than that of a structural steel building capable of carrying equally heavy floor loads.

Having elected to use reinforced concrete throughout, it was at first believed that an acceptable foundation could be provided by utilizing rather long concrete piles. The plot measures 70 feet by 80 feet; the edifice is 225 feet high above street level, and from the start it was recognized that the columns would have to bear individual burdens up to 600 tons. This meant exceptional concentration of weight. After further consideration it became evident that suitable concrete piles would necessitate foundations of such size as to involve prohibitive expense for excavation, concrete sheathing, pumping and the proper underpinning of a large adjacent building. How then was support to be provided which would safeguard against settlement if the foundation were to stop short of the underlying ledge? The puzzle was solved by the adoption of what are termed "pretest piles."

These consist of successively assembled sections of thin sheet steel tubing 3 feet long and 20 inches in diameter filled with concrete—the latter when solidified carrying the subsequently applied load. The first 3-foot sections of empty steel cylinders were driven into the earth by means of hand hammers. The soil within the short tubes was then excavated by spades and spoons, after which the metal shells were charged with concrete. The pretest piles or concrete columns were located after the manner indicated in one of the following illustrations in pits dug beneath the basement floor. The next step when the plastic material had hardened was to transfer to the pretest piles one by one the cumulative burden of the superposed structure which by then included the nearly completed first story of the building.

Temporarily wooden beams or shores were set upon the tops of the concrete-filled cylinders and these shores were long enough to engage the underside of the wall girders of the exterior columns and similarly to effect contact between the pretest piles and the continuous footings of the interior columns of the edifice. At that stage the bearing value of these novel piles was estimated to be ample to furnish a preliminary support of at least 70 tons of weight per column. Thus with a minimum of excavation all was made right for the beginning of the superstructure within a period of only three weeks.

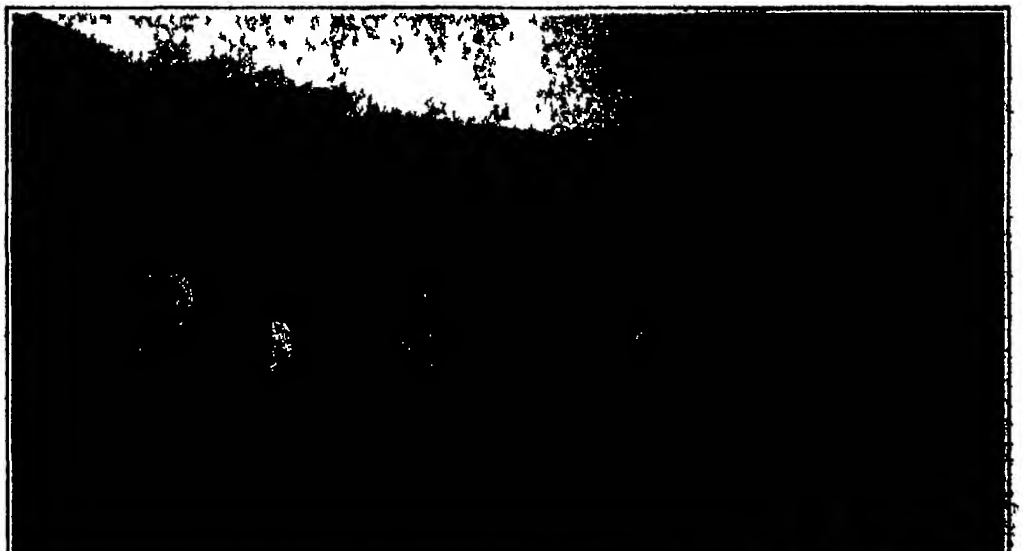
Five or six days later the mass of the superstructure had become such as to permit subjecting a few of the piles to a load test through reaction of 40 tons apiece. One at a time the wood shores were removed and whenever this was done an additional tube section was set over the concrete-charged cylinder already in place. This in turn was poured full of concrete and a bearing plate was laid across the top. At the proper moment two hydraulic jacks were interposed between the bearing plate and the exterior wall girders and pressure was applied in an effort to sink each of the concrete piles until the gage showed the desired test load. When the fourth floor above the street had been poured the average load on each column of the building was approximately 75 tons and then one pile of every group was subjected hydraulically to its final test load. The cylinders were designed to take a unit load of 50 tons and to prove their fitness to do this each was called upon to withstand an overload test of 50 per cent. The average penetration as a result of this test was about 3 feet into the coarse sand stratum already mentioned.

As soon as a cylinder refused to sink deeper under a pressure of 4,700 pounds to the square inch, a steel beam, cut to fit exactly between the top of the cylinder and the underside of the footing, was interposed vertically and wedged in place before the load on the two 4½ inch hydraulic rams was released. This effectually prevented the rebound of the pile and maintained the bulb of pressure of the soil at the bottom of the cylinder, thus obviating a settlement of 2 inches or more which would have occurred had the ground had a chance to react before a subsequent application of the rams.

One by one and at different intervals, each pile of a group was tested and a steel beam put in place. The beams were ultimately enveloped in concrete, and it is interesting to note that the last of the cylinders was not completed until the roof had been poured. As should be plain, this system of underpinning a building allows for the simultaneous erection of the superstructure and the forming of the foundation. Besides saving time and expense the method enables the constructors to measure continually the strength of the substructure and to make certain that it will carry the overload without any danger of subsidence. And now let us see how the work was done during the wintertime on the other parts of this rather unique edifice.

Preliminary operations for the setting of the empty steel shells of the pretest piles were taken in hand during the first week in September of last year. The ground floor was begun October 1st and finished twenty days later while the sixteenth floor was completed by the 24th of February, 1921. It is suggestive of the speed of progress that owing to inclement weather, activities were halted for fifteen working days in this interval. The season's rigors were very largely nullified by precautions adopted which rendered it feasible to push right ahead when the thermometer was well below freezing temperature, and herein the engineers and contractors in charge of the operations gave ample evidence of their resourcefulness.

As soon as the first floor was set and shored so that it would be able to take any load of sand or stone which might have to be placed upon it it was covered with planking and upon this was laid a system of perforated steam pipes. This installation was so controlled by a series of valves that steam could be introduced at will into the pipes of any bay. At times the floor sustained loads up to 700 pounds per square foot. On it was built a tank large enough to hold sufficient water for four or five batches of concrete, and this water was kept pretty close to the boiling point by means of live steam. The concrete was poured into the forms hot, and as soon as a bay or section had been poured the steaming material was covered by tarpaulins which were secured to suitable battens. Further, heat was fed from the salamanders into the space between the canvas and the surface of the solidifying concrete. But [illegible] the consummation of the



Jacking down a pretest pile by reaction against the overlying concrete girder

joint was any of the concrete frozen. For the wall columns the forms were made of 1¼-inch lumber which, in addition to producing beautiful lines, proved to be an excellent insulator against the cold. Heavy tarpaulins were draped over the outside of the building to hold the frost away from the concrete, and inside the structure glowing salamanders were disposed close to the walls.

During the execution of the task it was customary to pour a floor about once a week, and this speed of construction demanded that great care be exercised to prevent overstressing the fresh material. To this end five floors at least were regularly shored so as to afford a wide distribution of the load throughout the ripening period of the concrete. The engineers left nothing to guesswork in determining the actual strength of the concrete used, and they devised an ingenious way of testing the material at different times while it was maturing. Promptly after a floor slab had been poured a dozen galvanized iron cylinders, each 6 inches in diameter, were pushed into the plastic stuff. These cylinders were encased in pasteboard mailing tubes, which rapidly disintegrated, thus facilitating the withdrawal of the concrete-filled cylinders whenever desired. Samples were obtained in this manner successively at the end of one, two, three and four weeks, which permitted the experts to determine to a nicety the physical properties of the concrete as it ripened. This check upon the maturing process gave the engineers assurance that they could reduce the number of floors shored in safety whenever, to save time, this action was expedient. The concrete employed, *i. e.*, of 1:2.4 composition, attained a strength of fully 1,900 pounds in the course of 28 days. Slump tests were made daily.

Objection to reinforced concrete in tall buildings has often been advanced on the score that the columns would be uneconomical by reason of the large amount of floor space occupied by them. But in the case of this structure the critic has been answered by the adoption of ground-floor columns of not more than 38 inches diameter, and this in the face of the fact that columns in lower buildings of considerably less floor-carrying capacity have been installed of quite 48 inches diameter. In the present instance this marked saving in space has been achieved through the use of special steel reinforcement and a particularly rich concrete. In this structure it has also been found practicable to employ concrete curtain walls only 8 inches thick, whereas brick curtain walls in a steel frame building would have to be 12 inches thick to satisfy the City Building Code requirements. This gain of 4 inches in space around the entire perimeter and on each floor of the edifice is a matter of considerable moment.

In order to insure accuracy of line and a very nice adherence to prescribed contours, both foresights and backsights were taken on neighboring buildings before the column forms were set; and at frequent intervals during the various stages of erection the surveyor and his transit were employed to check up alinement. These precautions have insured results that are quite as good as those obtained with steel framing.

Flat steel slab form-plates were used uniformly in the construction of the building. They were 2 feet by 8 feet, and throughout their area presented absolutely smooth molding surfaces. These metal plates, owing to their conductivity, served admirably to distribute the heat from the salamanders—thus hastening the drying out of the concrete. The depressed panel forms were also of steel, and it seems that the application of the metal form-plates proved somewhat less expensive than wooden ones would have been for the same work.

Heretofore a considerable dimensional variation has been allowed in reinforced concrete structures, but in the present instance it was necessary that the elevator shafts should be kept to guaranteed measurements and vertically true, so that the cars could be ordered early enough to have them delivered promptly. When the building was only two stories high, the size of the cars was fixed, and from then on the elevator contractor was able to install his guides with the completion of each succeeding floor. Cars were in service in two of the four shafts a full month before the skyscraper was turned over to the owners.

The exterior surface finish is a feature deserving mention, because concrete buildings are all too often not pleasing in this respect. An unusual method was resorted to to assure satisfaction. Instead of employing cut limestone or molded concrete blocks as a facing for the two lower floors, the engineers, in order to carry out the monolithic effect in its entirety, adopted the novel expedient of casting the stone finish in place. No change was made in the manner of fabricating the steel reinforcement, other than that ½ inch expanded metal was wired to the rods. The space usually devoted to fireproofing was filled instead with surfacing concrete. The distance between the expanded metal and the outer form varied, according to requirements, from 1¼ to 2 inches. The surfacing concrete was hand mixed and rather dry and when ready was guided by means of a broad, flat chute into the narrow space between the expanded metal and the outer form. When in position the material was vigorously tamped with a tamper of special pattern. The structural concrete was poured between the expanded metal and the inside form. The facing concrete was handled so as effectually to prevent structural concrete from working outward to the exterior. This surfacing material was composed of white Portland cement and two parts of colored aggregate made up of quartz, feldspar and green stone chips. When suitably seasoned this composition was bush hammered by stone masons, and this treatment produced a beautiful effect. The upper sixteen stories were surfaced by electric carborundum grinding machines, in accordance with recognized standard practice.

The interior concrete was likewise finished by using electric carborundum grinding machines, and none of it was plastered. After grinding, it was sandfloated with wood floats. To facilitate this work, special take-down rolling scaffolds were built, and these enabled the operatives to forge ahead easily and speedily without waste of time. The final results are quite as good as sandfloated plastering, much more permanent and considerably less costly. Once more we have proof of the adaptability of concrete for structural purposes, and in rearing this skyscraper we are given evidence of the resourcefulness and the inventive cunning of the men who are bent upon making the most of this flexible building material. At a very recent date such a structure as this one would have been regarded as altogether out of the question.

The granite-like appearance of the exterior concrete after it has been bush-hammered

Left: The building during erection; the tarpaulins draped over the two topmost stories are to protect the new concrete against frost. Right: The finished structure—tallest building yet reared of reinforced concrete throughout

The Hide and Leather Building, New York

Water Regulation in the Body

IN a paper on "Water Regulation in the Body," in the *Journal of Physiology* (London) for March, Mr. E. F. Adolph, of the University of London, says: The addition to the body of water, alone or accompanied by various salts or urea, is not permanent. The solution retained for the greatest length of time is 1 per cent sodium chloride. Water may be abstracted from the body by a large variety of methods, several of which have been studied comparatively. When no other constituent has been abstracted meanwhile, the body-weight is completely restored by drinking water. Depletion of water does not inhibit the process of growth, though it seems that the contrary might be anticipated. The excretion of water, chloride, and urea during a diuresis due to any one of them is by far the most accurate indication so far at the disposal of the diagnostician for indicating whether the water of the body is normal in quantity.

The water content of the whole organism is independent of every other single substance. The content may be raised by introducing a temporary store of salt or carbohydrate, this water is not a part of the essential structure of the body. Other than this, no evidence has been found for a reserve of "free" water, and in thirst the excretion of water is kept up at the expense of water from the tissues themselves. This is the means whereby death from thirst is effected.

The Service of the Chemist

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Conducted by H. E. HOWE, Chemical Engineer

Filtering with a Powder

WHILE manufacturers are familiar with the use of coagulating agents as aids to filtration and have developed many serviceable filtering mediums, the use of a powder seemed to many of them like adding more objectionable material rather than removing it. But experiment has shown that the diatomaceous earth which is prepared for this purpose serves to keep open the pores of the filter cloths and in power presses builds up a porous cake through which the material to be filtered passes readily giving up its impurities meanwhile.

This powdered earth is able to overcome the slimes which cause so much trouble in food work. In filtering cereal beverages ¼ pound per barrel permits the use of the modern pressure filters and the filtrate is brilliant and clear. Yeast cells are entirely removed. Fruit juices and apple products are mechanically clarified when small quantities of this type of powder is added before filtration and catalytic agents used in the hydrogenation of oils are removed by filtering with it.

Another important application is in the clarification of crude and refined vegetable oils when its use decreases the amount of bleach required. Soap lyes and fats are clarified by using 0.1% of the diatomaceous earth.

Handbook on Shellac Industry

THE Indian government has included as a part of its publications Indian Forest Records a Report on Lac and Shellac which should command the attention of those interested in that important article. Of commercial interest are lists of the principal manufacturers, dealers and exporters in the lac centers. Then there is a bibliography on lac and shellac and reports of investigations into sources of supply, methods of production, manufacture, transportation, price fluctuations and volume of exports. Comprehensive colored maps are included, price graphs and the influence of stocks upon prices.

In the discussion of quality of shellac reference is made to the influence of cultivation and method of preparation and there is a deal of technical information.

A Catalyst for Hydrogenation

A BRITISH patent has been issued covering the use of a nickel wool which has been activated for the hydrogenation of fats. The nickel wool is treated with nitric acid after which the nickel salt thus formed is converted into the oxide and this reduced in hydrogen. This activated wool is packed in the reaction chamber through which the oil and hydrogen pass in counter current. The catalyst is regenerated by washing with hot oil to remove the nickel soaps, then removing the oil with solvents and finally heating in hydrogen.

Tests on Commercial Carbon Monoxide Indicators

THE Gas Mask Laboratory of the Bureau of Mines has been testing commercially produced instruments in which iodine pentoxide indicator is used to detect carbon monoxide. The results show that the instrument gives positive indications by the change of color with 0.07% or more carbon monoxide in air. By comparison with a color scale an average of 0.16% was obtained for air containing 0.15%, the lowest reading being 0.10% and the highest 0.23%. With an increase in the amount of carbon monoxide about the same order of variation was observed.

Air carrying smoke or flue gases caused no difficulty while determinations at freezing temperature and in artificial light were also good. Only one person in thirty experienced any trouble in determining color shades. The gases which might interfere with the test are removed in the apparatus by activated charcoal. These are acetylene, ammonia, benzene, ether, gasoline, hydrogen chloride, hydrogen sulphide, water vapor and natural gas containing members higher than methane. The following gases can be ignored: sulfur dioxide, phosgene, methane, nitrogen peroxide, chlorine, carbon dioxide and carbon tetrachloride.

No skill is required to make these determinations for carbon monoxide and less than a minute is required.

Zinc vs. Copper Roofing

MR. FREDERICK LAIST of a prominent copper mining company in an address before the annual meeting of the American Zinc Institute made some interesting comments on zinc and copper roofing. Zinc sheets are used for roofing abroad but have not been extensively applied for such purposes here. Copper, however is extensively used but as Mr. Laist points out copper must command a much higher price than zinc, and under ordinary conditions costs twice as much to produce as zinc. Copper seldom costs less than 13c per pound to produce. To quote from the address:

For ordinary roofing purposes copper can scarcely be considered a competitor of zinc on account of its necessarily much greater cost. While the average person is willing to pay one or two cents, or probably three cents per pound more for it he is likely to think a long time before paying seven or eight cents per pound more.

Now as regards the comparative life of the two materials. The converter building at the Anaconda reduction works afforded a very difficult roofing problem and many kinds of roofing were experimented with. Corrugated iron was first used and had to be replaced about every eight months. About ten years ago it was decided to replace part of the roof with copper which is still in fairly good condition, although some sheets have had to be replaced owing chiefly to lack of physical strength rather than chemical corrosion. Thicker sheets should have been used. After we became interested in zinc we decided to try out some corrugated zinc sheets on the roof of our converter building. These sheets, while they have stood up remarkably well, are not as good as copper and show the corrosive action of the sulfur gases. These sheets, too, are thinner than they should be, and therefore lack physical strength. However they stood the test better than might be supposed considering the extremely severe conditions, and have convinced me that zinc roofing for ordinary purposes would last so long that the question of life would not be of importance as determining the choice between copper and zinc.

It is interesting to note that last April the Anaconda Company produced more zinc than copper in its Montana smelters. This is electrolytic zinc of which 125,000 tons are now produced in the world—nearly one-half being in the United States. The electrolytic process makes it possible to mine zinc from a much greater variety of ores and concentrates than can be accomplished by any other means. The technique of the process has been described recently in the transactions of the American Institute of Mining and Metallurgical Engineers.

Mineral Tannage

IN his fourth article on this subject in *Collegium* W. Moeller discusses the tanning action of iron salts. He concludes the usual explanation of the instability of iron tanned leather that it is due to oxidation, is not correct since intact hide substance is very difficult to oxidize. Iron salts have a strong tendency to hydrolyze, and the ions especially hydrogen ion, cause hydrolysis of the hide substance in the leather. Organic salts are beneficial since they repress this hydrolysis. The slight tanning action of unneutralized iron and chromium salts is due to the fact that the hydrolyzed hide substance acts as an alkali, neutralizing a small amount of the salt and thus setting up a peptized or tanning system.

Wages in Chemical Industries

A RECENT report made to the Ways and Means Committee of the House states that the weekly wages paid to semi-skilled men in the chemical industry of various countries is as follows:

United States	[illegible]
Great Britain	[illegible]
Norway	[illegible]
Germany	[illegible]
Italy	[illegible]
Japan	[illegible]
Belgium	[illegible]

And yet there are those who fail to see why our chemical industries need special provision to establish them and encourage development!

Bacteria and Corn Cobs

MR. W. H. PETERSON of the University of Wisconsin, has found that 100 pounds of corn cobs can be made to yield 2.7 pounds of acetone, 6.5 pounds of ethyl or grain alcohol, and 2.4 pounds of acid, principally formic and acetic. This is accomplished by making a sirup from the corn cobs by hydrolysis with dilute sulfuric acid and then fermenting this. The sirup is chiefly xylose, and the bacteria which does the work is Bacillus acetoethylicum. Proper conditions of nitrogen and phosphate supply and hydrogen ion reaction must be maintained.

The fermentation is made continuous by providing cinders to which the bacteria may attach themselves in the container. The fermented solution can be removed and new sugar sirup added without disturbing the bacteria, and under these circumstances a rapid and vigorous action is maintained. The work to date has been done on a laboratory scale and no figures have been compiled on the strictly economic phases of the research.

Pelt Dyeing

THE July issue of the *Journal of the American Leather Chemists Association* abstracts an article in the *Deutsche Farber-Zeitung* by O. Berthold on pelt dyeing as follows:

After tanning the pelt which is to be dyed is prepared by maceration in a 1-3° Bé sodium hydroxide solution then washed in a large amount of 0.5 per cent sodium carbonate solution. In place of sodium hydroxide, milk of lime, sodium carbonate or ammonia of corresponding concentration may be used. The temperature should not be above 30°. The skins are then washed free of alkali are made slightly acid with acetic or formic acid and again washed. Mordanting previous to dyeing yields faster colors. The following mordants are recommended, the amounts in each case to be added to 1 liter of water: (1) potassium bichromate 2 grams, tartaric acid 1, copper sulphate 0.25; (2) potassium bichromate 2, tartaric acid 1; (3) potassium bichromate 2, acetic acid 1.2 cc 30 per cent; (4) copper sulfate 5, acetic acid 1.2 cc 30 per cent; (5) ferrous sulfate ½, acetic acid ½ cc 30 per cent, iron liquor 20-30 gr 20° Bé. These mordants may be used singly or in mixtures at temperature of 25-30°. For dyes ursols are recommended the dye being formed on the hair by the oxidizing action of hydrogen peroxide, the complete effect requiring 4-12 hours. A fine deep black on rabbit pelts is obtained, after the usual preparatory treatment by mordanting with copper sulfate and acetic acid for 15 hours at 30° and thorough washing, then dyeing in a bath containing ursol D 6 grams, ursol D G 2 grams and 120 cc hydrogen peroxide solution for 15 hours at 20-30°. The pelts are then thoroughly washed and placed in a fresh cold bath containing copper sulfate 0.5 gm. per liter for 2-3 hours, centrifuged without washing, and the leather coated with a solution containing sodium chloride 200 gms., glycerol 100 and egg yolk 40 per liter, when the pelts are dried, stretched and finished.

Methanol from Methane

A PATENT covering a method for the production of methanol from methane has been granted to E. H. Riesenfeld. In the August 2 issue *Chemical and Metallurgical Engineering* abstracts the patent as follows:

"Methyl chloride is produced from methane by any suitable process and then in anhydrous alcoholic solution is converted into dimethyl ether by a process of heating with caustic soda under pressure. The dimethyl ether is subsequently hydrolyzed to methanol under high pressure. The latter reaction is accelerated by the presence of the mineral acid. [illegible]

The Camera Turned Sculptor

FROM England comes news regarding a new process of "photo-sculpture," which has been developed as the result of two years of incessant experimenting on the part of Mr H M Edmunds of Brighton. By means of Mr Edmunds' process a carving in greater or less relief can be made from a solid object by use of the camera.

From a British contemporary we learn that there is nothing to prevent a photographer of ordinary skill, given the necessary combination of camera and projector, from making the photographic record, which is all that is required for the carving machine and when once such a negative is made it can be sent away to the works where the carving machine is operated, and any number of direct replicas in relief can be made from it, to say nothing of their reproduction by casting. The carving can be done either in relief or intaglio, at the will of the operator of the machine. As its name implies, photo-sculpture is a process by which it is possible to photograph a sitter or any suitable solid object in such a way that from that photograph a carving can be made in ivory, alabaster, wood, or other material.

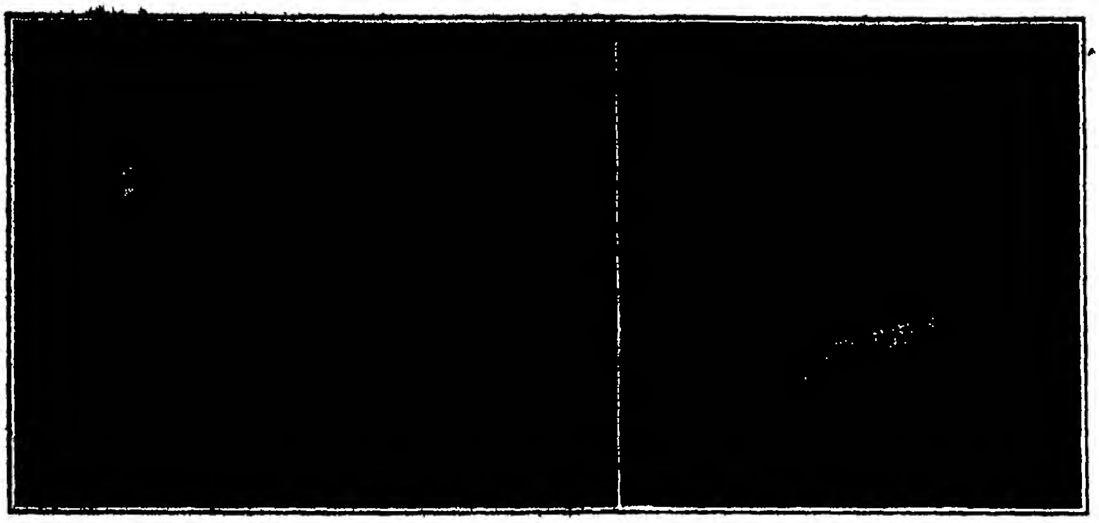
It is a little difficult for the ordinary layman to grasp how these carvings can be produced, and to understand the theory of their production calls for a knowledge of mathematics. However, Mr Edmunds explains that it is necessary first to imagine an optical projector constructed for use with a very long focus and well-corrected lens and a powerful source of illumination. The inventor has used with success a gas-filled incandescent lamp of about 1500 candle-power. In place of the ordinary lantern slide an accurately drawn spiral photograph on a sheet of plate glass is used. This spiral has a form like that of the groove of a phonograph record. The spiral is projected and focussed upon a plane surface at a distance of about 10 feet from the projector lens. A camera is fixed to the side of the projector with the nodal points of its lens lying in the nodal plane of the projector lens. For all practical purposes it can be said that the optical axes of the camera and projector lenses are parallel, and that a line joining the centers of the two lenses is at right angles to these axes. A photographic plate put in the camera at right angles to the axis of the lens will photograph the spiral projected on the plane surface, and will do so without distortion.

The broad principle by which the carving is effected is that by substituting any solid object of an irregular form for the plane surface, the distortions produced in the projected spiral give a record of the object, and so provide means by which the carving can be effected. The photographic negative obtained is carefully enlarged on to an opal glass which is necessary as the exact dimensions of the enlargement must not be altered by development, as would be the case if ordinary bromide paper were used.

We now turn to the carving machine in which the photographic record is utilized to produce a bas-relief of the sitter. The mechanical details of this machine are somewhat complex, but in its elements the machine consists of three parts (1) A face plate, which holds the material to be carved (2) a moving carrier which holds the photographic record, and (3) a high speed drill and microscope mounted up together, which can be moved in and out by a controlling lever. The operator of the machine merely has to follow the lines indicated on the photograph with the cross hairs of the microscope, moving the microscope to do this with the controlling arm already mentioned. In moving this microscope he also moves the drill, so that it cuts the material at varying depths according to the form of the original subject.

Up to the present the inventor has worked with 20 and 40 lines per inch, and he finds that the latter gives a more delicate and faithful rendering of the original. Whether an increase beyond 40 would be better he cannot say, but he believes that 40 represents the detail quite closely enough when looked at from the ordinary distance of two or three feet. The movement of the carrier of the enlargement is made to correspond exactly to that of the carrier of the material to be carved, both movements being mechanically locked together for this purpose. Mr Edmunds has good results in box wood, mahogany, and ivory, but has found the greatest ease of working in alabaster.

With regard to degree of relief this is a question which requires a good deal of attention, as certain subjects show up better with a relatively deep relief. The inventor has found that portraiture about a third to a half of the full relief of nature gives the best results.



Left: Carving machine, which translates a photographic record into a piece of sculpture. *Right:* Photographic record showing the spiral effect

Apparatus which translates photographs into sculpture

Static and Gasoline Fires

ONE of our large oil companies has experienced many fires due to the presence of static electricity either in the truck or service station, and to eliminate this fire hazard one of its employees has perfected the system shown in the accompanying views.

Each oil filling pipe at the service station is provided with a plug. Before the driver can open the filler cap for the purpose of running gasoline or distillate into the tank wagon it is necessary for him to insert the plug into a hole in the filler cap neck, as shown in our third view which action unlocks the latch thus permitting the cap to be opened. The act of inserting this plug carries off any static electricity which may be in the tank or truck chassis thus removing any danger of a spark causing a fire when the filler cap is opened. The plug is connected to a wire which is grounded. There is also a wire connected to the end of the filler cap, which is also grounded. In order to complete the circuit a 5 16-inch chain is attached to the frame and allowed to drag on the ground at all times.

There is still another danger from fire and that is when filling steel drums from a tank wagon. Some time ago a spark which was caused when a drum was being filled on a ranch started a fire which burned the tank wagon and the buildings on the ranch. For the purpose of eliminating this danger the oil company has perfected the device shown in the center view. This device is provided with a spring lock which holds the filling device firmly in the hole of the drum.

The service station presents about as complex a problem as can be found, owing to the numerous sources of static electricity. Under certain conditions refined oils passing through pipes generate static electricity. Each automobile comes into the service station charged with static in some degree depending on the weather. Should we endeavor to insulate the car we would only create a still greater hazard due to heavy discharges; hence we take the opposite course and make the path so easy that the building up of a charge becomes unnecessary and the charges are harmlessly led back to earth. This easy path is what is known as grounding, and it appears quite simple but as a matter of fact the several conduits and the motor frame present a little problem all their own.

It would be well for all automobilists to give some thought to the static problem when handling gasoline. No doubt too little attention has been paid to this phase, with many serious accidents as a consequence. There is greater danger of static during crisp cold, dry weather than in warm humid weather.

[illegible] of a gasoline filling station, showing the special grounding and cap unlocking plug inserted in the filler cap of tank and the grounding wire on the filling spout. *Center:* [illegible] which prevents [illegible] contact with the hole in the gasoline drum, and therefore eliminates danger of sparks. *Right:* Details of the special grounding and unlocking plug [illegible] filler cap of [illegible] tanks. The cap can only be unlocked and opened after the grounding plug has been inserted, thus removing any static charge

Some ingenious methods of grounding static charges and thus preventing the danger of gasoline fires during filling operations

The Heavens in December, 1921

The Mysterious Visitor of August, and Some Remarks about Comets in General

By Prof Henry Norris Russell, Ph. D.

IT is not always an easy matter to keep a series of articles of the present sort strictly up to date—and difficulty turns to impossibility when the news of observations is delayed in reaching astronomers themselves For example information is still dribbling in regarding the bright object seen at the Lick Observatory last August The group of aviators and astronomers who saw it on August 7th—as was told in these columns not long ago—were not the first to see the strange visitor An amateur astronomer in Detroit noticed it the day before about five degrees southeast of the sun Then it was seen, at sunset on the 6th by two amateurs in different places in England, and by at least one other in Germany Two days later an observation in the morning sky before sunrise was reported by a friend to Professor Douglas in Arizona—but details are not at hand even yet Meanwhile on August 8th remarkable bands of light were seen at Heidelberg crossing the whole heavens wide and bright as the Milky Way, and crossing it at right angles which were at once suspected to be a comet s tail

Putting all these data together incomplete as they are it seems certain that we have to do with a bright comet which passed perihelion late on the 7th or early on the 8th at a very small distance from the sun It evidently came from south of the ecliptic and receded sharply in the same direction, so that it was north of the plane of the earth s orbit for but a very few days Under these circumstances it would have been so far south of the sun when at any considerable angular distance from the latter that there could have been no hope of seeing it except from stations in the southern hemisphere Whether it was actually seen from some such point we do not yet know, and we must wait till the southern mails arrive to be sure

It seems likely however that this will be one more of the instances—fortunately rather rare—in which a comet may appear and vanish without a single observation being made of it which has the least claim to precision The great brightness of this comet makes the case more remarkable—though it is improbable that it could fairly be classed among the great comets The last daylight comet 1910 a was observed in full daylight and was probably comparable with this one Yet within a couple of weeks it had faded to an inconspicuous object for the naked eye and if set up at the same distance from the sun and the earth, it would have been an inconspicuous object compared with Halley s comet for instance Even the latter would compare poorly with a really great comet, that of 1811, of 1882 or Delavan s comet of 1914

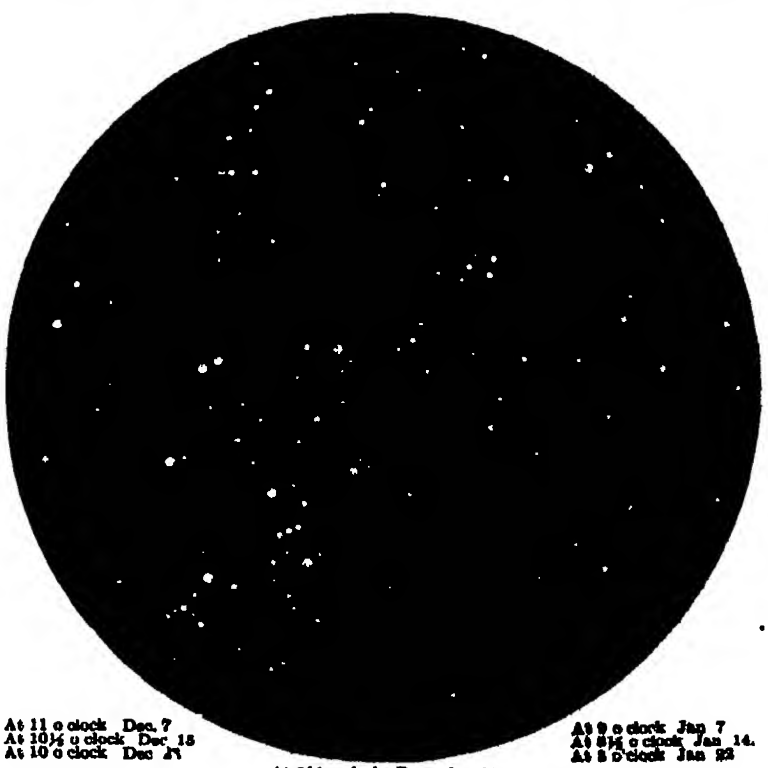
The present comet may have passed nearer the sun than that of 1910, which did not come nearer than about ten million miles. But this will remain very uncertain unless further and more accurate observations turn up Indeed even if we had three accurate observations (which are required for the calculation of an orbit) the problem for a comet which appears so near the sun admits three solutions That is, there are three possible orbits all of which would put the comet at the observed points in the heavens on the three given dates—though at very different distances from the earth Just this happened in the case of 1910 a, and the first orbits which were calculated differed enormously for some computers had hit on one of the three possible solutions and some on another Later observations made it possible to tell with certainty which was right, but we may not have any of these this time

Comets and Comet Searching

This whole episode emphasizes an opinion which has been growing in the mind of the writer and is probably shared by many astronomers namely that the watch for comets has become rather slack since the war, and that it is probable that a good many are getting by undetected This particular one to be sure may have been visible only to southern observers in the earlier part of its apparition but the number of cometary discoveries has fallen off in a way that indicates clearly that something is wrong

This affords an admirable opportunity for the amateur astronomer who has a fair sized small telescope, a clear sky, and sufficient patience Hunting comets is slow sport, but a year or two of honest work is likely to be rewarded A dozen years ago an undergraduate at Princeton, Mr Daniel, became interested in comet seeking, and in the three following years he discovered three comets—without spending so much strength as to interfere with his college work

The comet hunter should provide his telescope with an eye-piece of low power and large field of view He then goes out on a clear night, points his telescope anywhere in the sky and sweeps slowly across the heavens, watching the stars as they pass through his field of view When he has gone as far as he plans to go, he shifts his instrument laterally by an amount rather less than the diameter of his field of view, and sweeps back again, covering another long and narrow strip of sky, overlapping the first along one edge Then he makes another shift sidewise and returns, sweeping out a third strip and so on, as long as his patience will allow



At 11 o clock Dec. 7
At 10½ o clock Dec 15
At 10 o clock Dec 23

At 9½ o clock December 30.

At 9 o clock Jan 7
At 8½ o clock Jan 14.
At 8 o clock Jan 22

NIGHT SKY: DECEMBER AND JANUARY

All through his search he is keeping watch for objects which are not star-like in appearance—faint hazy spots or lumps of light If he finds one, the chances are that it is one of the many nebulae which are bright enough to be seen in small telescopes Consequently he must know enough to be able to find out the right ascension and declination of the object at which he is looking, and he must have some sort of a catalog of nebulae for reference

Sooner or later, if he does not become discouraged, such an observer will come upon some faint nebulous object which is not in the catalog of nebulae. He will then watch this with care, aligning it with stars in the field of view, to see if it is in motion. If it moves it is certainly a comet and his next duty is to determine its position in the sky as closely as the time and means at his disposal permit, and then to send a telegram to the central station established by astronomers—in this country, to the Harvard College Observatory—announcing his discovery, and giving details regarding the comet s position, motion and brightness The news will then be sent broadcast by wire, and other observers will get to work

Though the labors of the comet seeker may be long his rewards are considerable. Should he discover an "unexpected" comet (as opposed to one whose return has been predicted and for which an ephemeris has been published in advance), the comet will be known by his name and he will receive one of the medals which are regularly awarded for such discoveries by the Astronomical Society of the Pacific. There is a fair chance, too, that the comet may turn out to be of some unusual interest, it may be periodic, or may come near the sun or the earth, and be conspicuous to the naked eye In such case the name of the discoverer bids fair to be long remembered in the annals of discovery But more satisfying than these claims to fame must be the consciousness of the discoverer that he has made a definite addition to the sum of human knowledge, and borne his part in that laborious collection of data which forms the very foundation of the ever rising structure of science

The Heavens

As we go out in the December night for our usual survey of the skies, we find a splendid region in the southeast where Aldebaran shines high overhead Betelgeuse and Rigel appear below with the attendant stars of Orion, and lower still is the incomparable Sirius. To the left and a little higher is Procyon, and beyond still above, are Castor and Pollux Almost under the latter is Regulus, low on the horizon, while above, close to the zenith, is Capella

The Great Bear is coming up in the northeast, the Little Bear and Draco are below the pole, and Cassiopeia is high in the northwest Pegasus is conspicuous in the west, with Andromeda above, and Perseus still higher Eridanus and Cetus, which together fill the southwestern sky have hardly a single bright star Each of them, however, possesses one of the nearest of the stars visible to the naked eye—Epsilon Eridani and Tau Ceti These two stars are both at a distance of about ten light years—a little farther off than Sirius, but probably a little nearer than Procyon

The Planets

Mercury is a morning star at the beginning of the month, and rises just before 6 A M so that he should not be hard to see. As the month progresses he draws in behind the sun and disappears, passing through superior conjunction on the 27th and coming out as a morning star in January

Venus is a morning star and is also getting closer to the sun, On the 1st she is a little less than three degrees west of Mercury, and rises about ten minutes earlier, while at the end of the year she is only a little more than ten degrees from the sun, and is almost lost in the dawn

Mars is also a morning star, but the sun is moving eastward faster than he so the two are drawing apart He is in Virgo, and passes within four degrees of Spica on the 11th At this time he rises at 2.30 A. M. and is therefore easy to see

Jupiter and Saturn are still near together in the morning sky Both are in Virgo but Jupiter, with his more rapid eastward motion, is receding from Saturn, while Mars, recently their near neighbor, is running ahead of both. On the 29th Saturn comes into quadrature and rises just at midnight—three-quarters of an hour before Jupiter, and two hours before Mars Uranus is in Aquarius, visible only in the early evening, and Neptune in Cancer, observable after midnight.

The moon is in her first quarter at 2 A. M. on the 7th, full at 10 P M. on the 14th, in her last quarter at 8 P M. on the 21st, and new at 2 A. M. on the 29th She is nearest the earth on the [illegible], and farthest away on the 6th. During the month she passes near Uranus on the 6th, Neptune on the [illegible], Saturn and Jupiter on the 22nd, Mars on the [illegible], Venus on the [illegible], and Mercury on the [illegible]. The conjunctions with Jupiter and Mars are close, but neither is visible from our longitude.

Eliakim Hastings Moore

By Marcus Benjamin, Ph.D.

FOLLOWING the old rule that the office of the president of the American Association for the Advancement of Science should pass from a representative of the natural sciences to one of the physical sciences, this year a brilliant entomologist gives place to a distinguished mathematician.

Eliakim Hastings Moore is the son of the Rt. Rev David H. Moore and Julia Sophia Carpenter Moore, and was born in Marietta, Ohio, on January 26, 1862. His father was an eminent clergyman of the Methodist Episcopal Church, who served as an officer during the Civil War, attaining the rank of lieutenant colonel, and later, as a bishop in his church, was stationed at important posts. It was while his father was serving under Sherman that the son was born His early education was received at various schools as his father filled pastorates in Ohio and Colorado, and he was fitted for Yale, where he graduated in 1883 with the degree of A.B. Then pursuing higher studies he received the degree of Ph.D, two years later, after which he spent a year at the University of Berlin

On his return from abroad he turned to his Alma Mater, and during the years of 1887 9 he served her well as a tutor of mathematics. But a call from the West took him to Northwestern University, where from 1889 he was assistant professor, and during 1891-2 associate professor of mathematics

In 1892 came the most important event of his career, for the University of Chicago, then at the beginning of its development, invited him to the chair of mathematics and he became a member of that brilliant faculty of young scientists who have made that university one of the most important factors in the history of the recent growth of education in the United States, and conspicuously in connection with its graduate schools

From its beginning in 1892 till the present the history of the department of mathematics in the University of Chicago has been one of steady growth Professor Moore is still the head of the department, but according to a recent catalogue he has with him a staff of seven associate professors and as many more assistants and fellows. The same authority shows that students may make a selection from 36 different undergraduate courses and from perhaps fifty graduate courses. Professor Moore has been exceedingly fortunate in both his antecedents and his environment and a review of the various departments of mathematics connected with universities in the United States would unquestionably show that the one in the University of Chicago is preeminent in the amount and importance of its original research, also in the number and importance of places that its graduates have been called to fill, as well as from the large number of its staff that have achieved the honor of an election to the National Academy of Sciences.

In addition to his professorial duties he has found time to devote much of his attention to original researches, but these have been exceedingly technical. They have been, for the most part, in that branch of mathematics known as General Analysis, particularly in that portion of the subject in which there is involved one or more general classes of general elements. In such cases effort is made to find by suitable determination of terminology and assumptions, general theories of which the classical theories are particular instances, and which for this reason have their central features in common And so the general theory of linear operations, which is akin to integration, has been his favorite field of study As typical of his thought may be cited his theory of linear integral equations in general analysis on generalization of the classical Fredholm Hilbert Schmidt theory, presented in 1911, and more recently his theory in generalization of Hibbert's theory of limited quadratic forms in an infinitude of variables.

His other activities have included the editorship of the Transactions of the American Mathematical Society (of which organization he was president in 1901-03) during 1899-1907, also since 1915 he has been an associate editor of the Proceedings of the National Academy of Sciences. During the World War he served his country as a member of the National Research Council and was chairman of its mathematical committee during 1917-18.

Honors of various kinds have been conferred on him in recognition of his great knowledge of mathematics. These have included an honorary Ph D, from Göttingen in connection with the unveiling of the Gauss-Weber memorial in 1899, and an LL.D. from Wisconsin, as well as a Sc.D. from his own Yale in 1909, and also [illegible] from Clark in the same year.

He is an associate fellow of the American Academy of Arts and Sciences since 1901; a member of the National Academy of Sciences since 1901; and of the American Philosophical Society since 1905. His foreign societies include corresponding memberships in the British Association for the Advancement of Science, membership in the London Mathematical Society, the Deutche Mathematiker Vereinigung, and the Circolo Mathematico di Palermo, and he was a vice president of the Fifth International Congress of Mathematicians held in Cambridge, England, in 1912

Professor Moore joined the American Association at its third Washington meeting in 1902 and was advanced to the grade of fellow a year later He naturally affiliated with the Section on Mathematics and Astronomy, and in 1910 was chosen a vice president of the Association, presiding over the section at the fourth Washington meeting in 1911 The high office of President of the Association is almost without exception conferred upon the foremost representative of some special branch of science in the United States and therefore Professor Moore's election at the Chicago meeting held last December, at once indicates that in the opinion of his colleagues he ranks first among American mathematicians, a decision in which there can be no dissenting voice.

Eliakim Hastings Moore, incoming president of the American Association for the Advancement of Science

Zirconium, the "Mystery Metal"

ON account of various properties and uses that have been attributed in the popular mind to zirconium, it has at times been styled the "mystery metal" says the United States Bureau of Mines An investigation regarding the preparation and uses of metallic zirconium and its salts has been conducted by the Bureau of Mines, and the results are just now made public

The compounds of zirconium have numerous important uses and more uses will doubtless be found Investigations in recent years have indicated that sintered or coherent zirconium metal is very resistive to acids, that it can be used for electrodes and it probably will find metallurgical uses A steel containing zirconium has been proposed for use in armor plate and automobile parts, and nickel zirconium alloys have been suggested for high speed cutting tools and for cutlery Numerous articles in scientific journals have recommended the use of zirconium oxide as a refractory, an abrasive a pigment in paints and as an opaquing agent in enamel ware The salts have been used in the textile industry as a mordant or dye-fixing agency, and also for weighting silk

Zirkite firebrick are used for furnace lining as well as for other purposes where a refractory having a low coefficient of expansion, high melting point, and maximum resistance to slag corrosion is demanded Although zirconium oxide has not proved satisfactory for gas mantles nor for arc lamps, it has been used for polishing powders, insulators for both heat and electricity, and with fair success in the Nernst lamp Being absolutely non poisonous, zirconium oxide is finding a use in paints and lacquers, where its resistivity to physical and chemical agents is proving highly valuable. As an abrasive, zirconia, zirconium silicide and zirconium carbide are suggested for a variety of uses, the carbide particularly as a substitute for the diamond in cutting glass. Zirconium oxide, because of its non-toxic nature is used in place of bismuth, nitrate or carbonate in Roentgen therapy It is also said to have some medicinal value Zirconium oxide and nitrate have been suggested for use in the extraction of oxygen and nitrogen from the air There have also been statements to the effect that the oxide may find use as a filler in the manufacture of rubber goods

In flashlights amorphous zirconium mixed with certain oxidizing agents burns with a bright light but it is doubtful whether the metal would be cheap enough to use in place of the usual material Coherent white zirconium metal, on account of its acid resisting properties has been suggested as a substitute for platinum in certain cases Its alloys have been suggested in the manufacture of rust resisting apparatus Crucibles prepared from zirconium oxide were proved in the experiments of the Bureau of Mines to be superior for high temperature work to any crucibles procured on the market

Zircon is found in considerable amounts in many placer deposits derived from disintegration of granitic and pegmatic rocks The best known deposits in the United States are near Green River Henderson County, N C and in the Wichita Mountains near Cache Okla Zircon is found most abundantly in certain syenites of Norway and occurs in crystalline limestone at Grenville and elsewhere in Canada Dana states that zircon occurs in various localities in North America including Litchfield Md Essex County Orange County and in St Lawrence County N Y near Reading Pa abundantly in the gold sands of Burke McDowell Polk, Rutherford Henderson and other counties in North Carolina with astrophyllite etc in the Pikes Peak region in El Paso County and at Cheyenne Mountain, Colo In California and elsewhere it occurs in gold-bearing gravels

Baddeleyite (brazilite) is found in large deposits in Sao Paulo Brazil This mineral has also been identified in Ceylon Sweden Italy and Montana Samples of zircon sand from Pablo Beach Fla have been investigated and recently as much as 3 per cent of some of the auriferous sands of Idaho has been found to be zircon mixed with some monazite

In Brazil which is an important source of industrial ores it is difficult owing to the hardness of the ore to drill holes for explosives and in handling large amounts resort is had to quite primitive methods A large fire is built against an exposed face of the ore and kept burning for several hours at the end of which time water is thrown upon the ore which produces fracturing of the mass permitting it to be sledged into pieces easily handled by one man Most of the mines are many miles from the railroad Horses for other than saddle purposes are practically unknown and the ore is transported to the railroad station by oxcarts carrying about one ton each These carts are of the crudest character having large solid, wooden wheels, some 4 feet in diameter and 6 inches in thickness From 20 to 30 oxen are generally required for each cart, owing to the mountainous roads

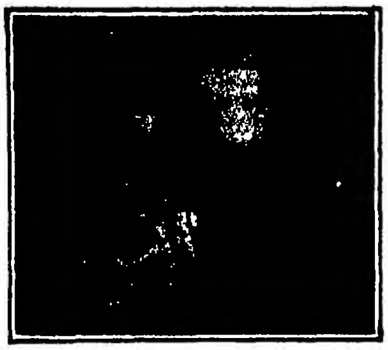
A New Fire Alarm Operated by Smoke

A NEW form of fire alarm has been invented in England It depends upon its action on the presence of smoke and is not affected by temperature changes which usually are the chief factors in the operation of most fire alarms The smoke detector consists of a metal cylinder some 8 in long and 2 in. in diameter, open at each end, so that air can circulate freely through it, and containing two rectangular metallic capsules, one of which is considerably larger than the other The detector only one of which is required for each apartment to be protected, is fixed in a high central position, to which the smoke on the capsules is to cause one to bend more than the other The differential movement is employed to complete an electrical circuit through a relay and, by means of the latter, a large electric bell or other alarm signal may be operated The apparatus can be used either independently or in conjunction with detectors depending on temperature effects, but it is said to have the advantage over the latter, that its action is more rapid and reliable In many fires dense smoke would be produced before any material rise in temperature occurred and moreover, the smoke would rapidly fill the whole apartment while the temperature rise would remain purely local for some little time

More and more the advantages of fire detectors of one type or another are coming to be appreciated, especially in country homes. This, in large measure, is due to the fact that the fire detector is a fit companion for the handy fire extinguisher, which is such an effective means of combatting a fire if taken in the early stages.

Inventions New and Interesting

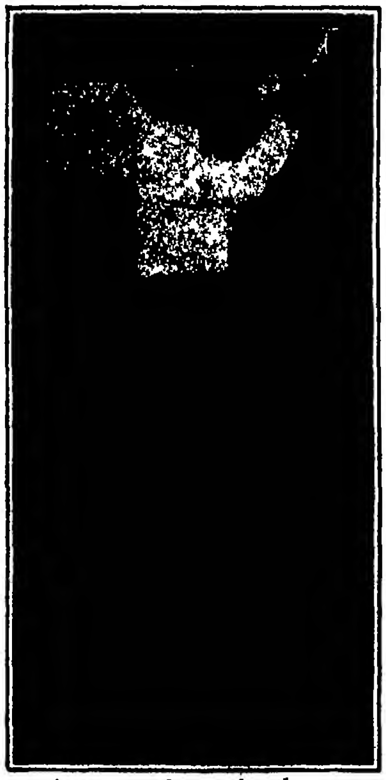
A Department Devoted to Pioneer Work in the Arts



Carpet renovator for home use

Carpets Cleaned at Home

NO longer need the busy housewife pick up her carpet and send it to the factory to be cleaned. She can have it done right in the house and on the floor. A new machine has been invented and is being used with success. The machine looks somewhat like a vacuum cleaner. In the container that is shown mounted on top of the carrier a solution of hot water and pure soap is dissolved. It runs through a superheater at the side of the car through a regulator which allows the liquid to flow on the inside of two bath sponge applicators. These scrub the transformed water into rich soapsuds while oscillating at the rate of 500 revolutions per minute. Behind this is a squeeze-rod which squeezes the moisture from the carpet or rug, at the same time sucking up all the moisture and dirt into a lower container in the machine and leaving the carpet almost dry. Though water is used as indicated, the results are in no sense less unsatisfactory than those we have learned to expect from dry-cleaning.



A vacuum cleaner for the car upholstery

Prices per Pound and per Foot

RETAIL dealers in cordage and rope find as a regular thing that they must sell it by the pound, since this is the basis on which it is bought. But the customer wants to buy it by the foot, since that is the way he uses it. The dealer who is asked how much a given length of a certain rope will cost has no means of answering the question save by cutting off this length and weighing it, and if the customer then decides that he can afford a better grade or that he must make a poorer one do, there is a loss. So one rope manufacturer has carefully figured out the weight per linear foot of all his ropes, and has put the result up in a most convenient form. The dealer has only to figure the price per pound which he must get for his rope to let him out with a proper profit. The "table numbers" at the heads of the columns on the chart correspond to these prices in a simple way, having decided on his price per pound, the dealer picks out the appropriate column and confines his attention to it. The slide can be centered on any desired column, and the chart then tells how much 100 feet—and by simple calculation how much any other length—of each style of rope must bring. In this way the dealer can buy by the pound, as he must, and sell by the foot, as his customers must insist upon his doing.

This chart translates buying prices of rope by the pound into selling prices by the foot

Cleaning the Closed Car

A NEW vacuum cleaner, designed and built primarily for cleaning the upholstery of closed cars, has just been put upon the market. Every owner of a closed car knows what a problem it is to get rid of the dust and dirt that settles in upholstery. It is the most difficult kind of dirt to dislodge, and yet it quickly yields to the vacuum method. The powerful suction rapidly draws the grit into the dust sack as it is loosened from the upholstery.

The cleaner is portable and easily carried about from place to place, and very convenient to operate. When in use it is placed on the ground outside the car, away from the operator, and not interfering with his work. A 10-foot length of flexible hose is furnished, on the end of which is attached a swivel hand-grip or nozzle. This construction permits freedom of motion at all angles, regardless of how much the hose is twisted about. The brushes, of China bristle and leather bound, will not injure the most delicate fabrics.

An Accurate Internal Micrometer

IN the manufacture of special tools, and in the duplication of accurate machine parts, difficulty often is experienced in measuring bores with extreme accuracy. To facilitate the taking of accurate internal measurements the tool shown in the accompanying illustrations was developed.

The operating mechanism involves four measuring jaws having a line contact with the internal cylindrical surface to be measured, and a micrometer screw that controls and registers the position of the jaws as they are moved in or out on inclined supporting surfaces. The four measuring jaws, which are provided with accurately ground and lapped cylindrical surfaces, are supported and held in allnement by close-fitting dovetail slots. A longitudinal movement of the measuring jaws of 0.005-inch increases or decreases the diameter of the measuring surfaces 0.001-inch. As the longitudinal movement is recorded with a micrometer screw, extreme accuracy is assured. Elimination of backlash in the micrometer screw and a close fit in the dovetail jaw grooves produce a tool that is practically as firm as a solid plug gage.

Provision for taking up wear is provided by a series of serrations on the sleeve that carries the micrometer graduations, and a similar series of serrations on the knurled handle which is fastened to the micrometer screw. By moving the graduated, serrated sleeve one notch an adjustment of 0.0001-inch is made. Any amount of adjustment up to the capacity of the tool, namely, 0.070-inch, can be secured.

After it is standardized by light waves the micrometer is used to verify the master reference ring gage that accompanies it. The series of concentric holes in the ring gage is provided to facilitate air circulation, which permits the ring to accommodate itself rapidly to normal temperatures after it has been heated or cooled in use.

The internal micrometer being checked up on its master reference ring-gage

In use, the micrometer is easily manipulated. It is inserted in the hole to be gaged with the jaws undersize and the micrometer head is turned until the jaws are stopped by the surface being measured. By referring to the reading the amount is readily ascertained.

The manufacturers of this ingenious tool have gone a step further, and provided also an internal thread micrometer. This corresponds in every detail to the plain internal micrometer, except, as indicated in our picture, for the use of threaded measuring jaws in place of the plain ones of the simple instrument. These jaws may be had with any desired number and style of threads, and the instrument is sufficiently rigid, in spite of its control from the micrometer screw, to insure that when the threads are once set in continuation of one another so that the apparatus will take the threads of the hole being gaged, they will remain in this adjustment.

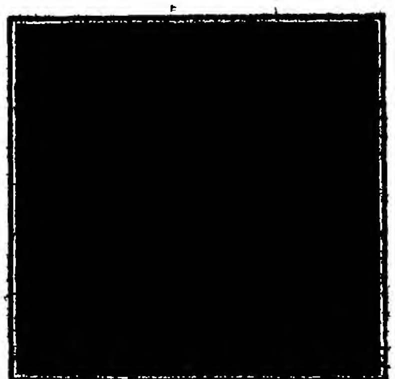
The internal micrometer with screw-gaging attachment

To Help the Short-Legged Man Upstairs

WOUNDED or slightly deformed persons who have one short leg, but who do not under ordinary circumstances need to advertise their infirmity by wearing a shoe of extra height, find nevertheless that in going upstairs their difficulties are materially increased. A French inventor has brought out what he calls a step-slipper for use in such cases. Its construction follows closely the lines of the conventional open-bottom cripple shoe, but as the illustration at the bottom of the column indicates, it slips on and off with a motion of the foot, much after the unpleasant habit of the familiar bath slipper, which is always falling away at the heel.

The Theft-Proof Car

THE latest thief-proof attachment for the automobile, while a diagram showing its operation would be rather complicated, is extremely simple in form and not difficult to install. It con-



A shoe for the use of the slightly crippled, in going upstairs

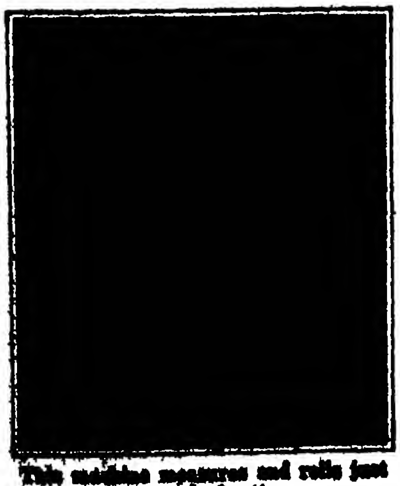
When the circular disk is replaced by the diamond one, the engine is without a spark

sists of a two-way switch mounted on the mud-guard, and wired up in such a way that the ignition current must pass through it. This it can only do when the round disk shown in the photograph is in place and locked in. On leaving the car, the owner removes the round disk and puts in its place a diamond-shaped one. This not alone fails to close the ignition circuit, but it completes a secondary circuit in such manner that any effort to tamper with it, to remove it without unlocking it, to short-circuit the ignition current around it, etc., will result in setting off a loud warning siren.

One Pound of Cotton

"ROLL your own," an injunction of the cigarette-tobacco manufacturer, is a phrase that now has significance in the preparation of packages of cotton for marketing. A machine designed by J. F. Barghausen, investigator in agricultural technology of the United States Department of Agriculture, is capable of rolling cotton into one-pound packages for length standards as prescribed by the Bureau of Markets in the marketing of the staple crop.

The simple device consists of an endless canvas belt adjusted on four wooden rollers, one of which is so arranged as to tighten slackness as desired. This roller is controlled by a foot lever, subject to the manipulation of the operator. One of the top rollers is in a receptive mood for opening in admitting the one pound of cotton on the conveying belt. The roller is then closed, and a hand wheel—in this instance a wheel from a coffee-grinding machine—is turned by hand half a dozen revolutions. The roll is thus formed. In this position the paper for covering the package, with an adhesive sticker on one end, is inserted and automatically travels around the potential bit of cloth. A few turns of the wheel secures the covering around the cotton.



This machine measures and rolls just a pound of cotton

Until recently length types of cotton in the standardization of the product were prepared by hand. Cotton specialists of the Bureau of Markets, drawing salaries ranging from $3500 to $4500, tediously converted the soft substance into one-pound packages altogether by hand. Four men, working all day, rolled forty of the small bundles. By the use of the newly built machine, 110 packets are bundled in eight hours and the services of three cotton specialists may thus take more useful directions.

The Motorcycle Spray

FIVE hundred and ten acres of potatoes, owned by a Washington state rancher, were in danger of destruction by the potato bug. The little pests were working so fast that it did not seem as though any means of extermination could possibly keep up with them, let alone catch up with them. But the rancher was a resourceful soul, and he attached an insecticide spraying outfit to the side-car chassis of his motorcycle, utilizing the power of the machine for traction and for spraying. With this outfit he found it possible to spray 190 acres per day with Paris green, whereas a horse drawn sprayer would by no expedient have been able to get above 35 acres. With the exceedingly hot, dry weather that was so general during the past summer, a day's delay might well have spelled ruin for the crop, but the motorcycle saved the situation.

This motorcycle carried a spraying outfit over 510 acres in less than three days and saved the potato crop

A Swivel Arm Micrometer Holder

SWIVEL-CHAIR officers were freely criticized during the war, but a swiveled arm developed by the U. S. Bureau of Standards was an important factor in holding micrometers for measuring pitched diameters of screw threads for the Ordnance Department. The simple device is likewise of value in times of peace when the production of thread gages is essential, the swivel mechanical arm filling a niche where the operator is unable to supply a third hand.

Formerly in testing screw threads a rigid mechanical arm was used, the apparatus holding the micrometer rigidly with the faces parallel to the axis of the gage, which in this instance was necessary with the use of two wires. The three-wire method of measuring screw threads is preferable, using the flexible arm which leaves the micrometer with a free movement in taking up its position with its faces parallel to the axis of the gage. Likewise, the observer who is the possessor of only two hands finds machinery coming to the rescue.

A Safety File for the Home

HERE is a new and novel semi fire-proof filing cabinet for the home. Just the thing in which to file away insurance policies, lodge dues, cancelled checks, notes, certificates, coupons, bonds, gas bills, grocery bills, clothing bills, private letters, or anything else that is important to put your hands on when the occasion demands.

The average home has important papers of all kinds scattered all over the house, in bureau drawers, in vases, on shelves, in books, underneath dresser scarfs, in closets and in a hundred and one other places where half the time they cannot even find them themselves.

Oftentimes this is the cause of serious delay and embarrassment. In the case of a fire these papers, which likely as not include the insurance policy, could not be saved. It is not because people are careless, but it is because they have really no one good safe place to put everything of value. The new holder encourages system. It not only serves every purpose of a safe but with an index it classifies everything the minute you drop it in.

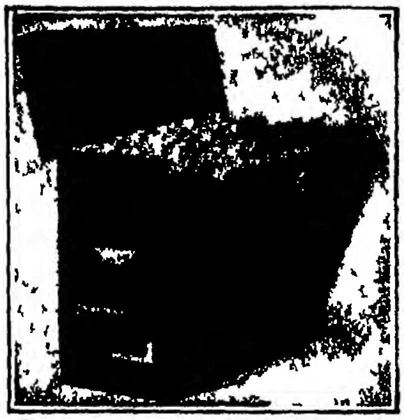
This file is made of the best grade of thin highly polished automobile fender steel, size 6x10x12 inches, holding 1000 full size business letters. The weight is only four pounds without the index. There are no bolts or nuts; everything is securely riveted together.

The Illuminated Seat Diagram

ALL of us have had the experience of poking and groping about in the darkened motion picture theater for a seat that we were not at all sure was there. A California invention will obviate at least the uncertainty, if not the groping. When there is thirty pounds pressure, or more, on the seat, nothing happens; when there is not, the seat sits high enough, on the top of a light spring, to insure that a contact will be made that will light the lamp corresponding to the seat in the diagram displayed at the door. No light, no seat; so all the incoming patron has to do is pick out the seat he wants and make for it.

Why Fire Departments Are Motorized

THE annual report of the fire department of La Crosse, Wis., impressively illustrates the economy of motor-propelled over horse-drawn equipment. Three triple combination trucks now in service traveled 701 miles to respond to 296 alarms during 1920 at a total expense to the city of $602.89. During the same period fourteen horses used by the department consumed feeding stuffs costing $2,488.18, and the horseshoeing bill for the year amounted to $688.90 additional. The recommendation that three additional trucks be purchased at once, supplanting nine horses, probably will be carried out without further delay.

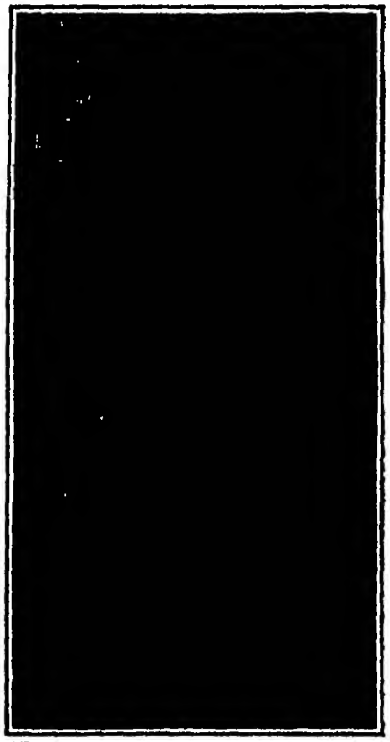


Semi-fire-proof file for home and general use

Time Combination Lock

THIS lock differs from all others in its construction and operation; at the same time it is adaptable for general uses. The working of it depends upon the length of time allowed for the mechanism to operate and this is regulated by the individual user. Each mechanism is made of three clock wheels and is a complete unit in itself, the numbers from 1 to 60, indicated on dials being controlled by such units. Any one of these numbers may be selected for use and the operator sets the combination with a key accordingly. When two mechanisms are used a choice of any one of the numbers of 60 times 60 or 3600 is afforded; three mechanisms enable the operator a choice of 60 times 3600 or 216,000 numbers. Only two mechanisms are necessary to make a practical and efficient working lock, the larger number of mechanisms being more especially adapted for safes and vaults.

One number of each mechanism is selected to be used in operating the lock, such choice being at the option of the individual user and may be changed at any time, thus precluding the possibility of any person's opening it other than the one who knows the combination. Either a watch or the indicator hand on the dial may be used for counting the seconds or exact time when the lock will



The presence or absence of lights on this board tells whether the corresponding seats inside are occupied

open The indicator hand, made of radium and visible in the dark makes one revolution per second To operate the lock on the combination of A 7, B-6 turn the indicator to the right so arrow points to A. This allows the mechanism to run seven seconds then turn indicator immediately to B which allows the mechanism to run six seconds, and the lock is then open To unlock it turn the arrow back so it will point to zero The lock requires no winding, its operation being automatic and it is made to be used both with and without keys These mechanisms may be fitted to ordinary key locks thus making a combination lock of increased efficiency and usefulness Being operated by clock work mechanism, all tumblers and noises are eliminated, making it impossible for anyone to know the combination of numbers used and which must be known by the person who opens the lock The lock can be made any size and is adaptable to all purposes.

A Carrier for Neckties

A GREAT many things have been devised to hold neckties but few as ingenious as the design shown At a first glance one would hardly appreciate how very handy this little roll really is and the number of articles it will hold. Here we have nine four in hand ties six bow ties one-half dozen handkerchiefs a very neat little pin cushion in the upper righthand corner for the tie pins etc and just below that there are four pockets to store away your collar buttons cuff buttons shirt studs and other miscellaneous articles to use when needed

One of the best features of this holder is that when one once places the ties in their proper place they will never need to be disturbed in making the selection of the one desired to be worn In other words you can pick out just the tie you want without removing any of the others from their respective places whether that tie happens to be on the bottom or on the top

A like invention for the ladies, made up in beautiful fancy leathers holds two pairs of long gloves four pairs of short gloves, six veils a dozen handkerchiefs, hair nets, miscellaneous articles and a divided pocket for various sizes of hair pins with a pin cushion in the upper righthand corner slightly larger than that on the men's holder for pins, brooches, lavallieres etc

Drying Camera Parts

THIS wheel—or series of wheels—is used for the purpose of drying the glue quickly that holds together the wooden parts of a motion picture camera The cameras are large, and pieces of wood of sufficient size are difficult to obtain Hence recourse has to be had to this method The workman, after glue has been applied to the proper faces clamps the parts in place Heat is artificially applied from below and the temperature of the room is also high. With the spin of the wheel the glue is dry, and the operator is ready to put in more pieces to undergo the same process

News Pictures by Wire in Plain Morse Code

DESPITE the facts that it was not held until 4 p m., Pacific standard time and took place nearly 3500 miles away the Los Angeles *Times* printed, on the morning of the day after the conflict a correct picture of the Dempsey-Carpentier knockout There was much interest in this achievement at the time but it is only now that it is possible to explain how the picture was transmitted The procedure was simplicity itself, and seems rather to take the wind out of the sails of those who have devised elaborate electrical apparatus for telegraphic transmission of pictures.

A half tone screen was made by ruling lines on sensitive paper or film and on this a print of the original photograph was made. The lines were sufficiently close together to make them available as a reference frame for the identification of points on the sheet. This idea is a familiar one perhaps most often met in connection with the index for a map where we are told that Metropolisville will be found in section A-6 and Big City in C-13. We all know [illegible] horizontal line labelled A, [illegible] 6, and somewhere in the [illegible] section we find the [illegible] olisville.

We could not construct a map [illegible] the index, because the lines are too far apart and the [illegible] tions given us by the index to locate Metropolisville at A-6 would not be sufficiently definite. But if we [illegible] the spaces between the two sets of lines so that we have a very close network with meshes only a few thousandths of an inch wide, we shall eliminate this difficulty, and a map indexed from such a [illegible] tem could be reproduced from the index with a very satisfactory accuracy. That is all there is to the *Times'* system of picture transmission.

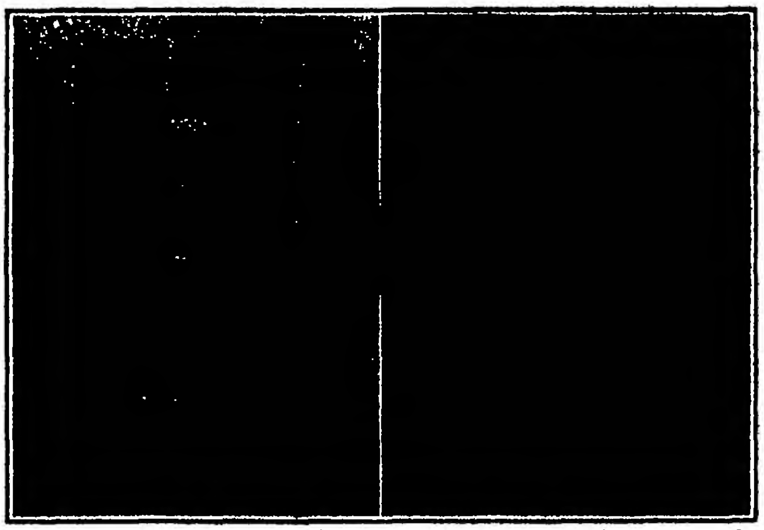
The sending operator decides just which lines of the picture are necessary for its proper form. These of course will include all outlines, they will include, in the case of the fight picture, the internal lines that define faces, garments, etc The operator merely follows these lines with eye or pencil notes the index numbers of the various line intersections through or close to which it passes, and puts these on the wire Explanatory remarks are interlarded where it is expected that they may be of aid in the operation of reconstructing the picture at the other end.

As a sample of how the thing works, the *Times* prints part of the message received. The sender was just beginning on the outline of the victor, and so informed the receiver by the first word of this portion of the message 'Dempsey 26-31¾, 31-33 33-33¾ 34-34, 35¾-34, 35½-33, 36-82 37-30 37¼ 99½, 39-79¼ 42-80¼, 43-80½ 44-80¾, 45-81 46-82, 47-83¾, stop. 47¾-83¼ and so on. It will be noted that short cuts are here used rather freely If no points were to be skipped, it would of course turn out that two successive entries, no matter how great a difference they might show in the horizonal (or vertical) index number, could not display a greater difference than one in the other index number For every time we cross one of the index lines we define a point which can be coded. But when the despatcher finds a line that runs to all intents and purposes straight from 37¼-99½ to 39-79¼ he begins it simply by naming these two points.

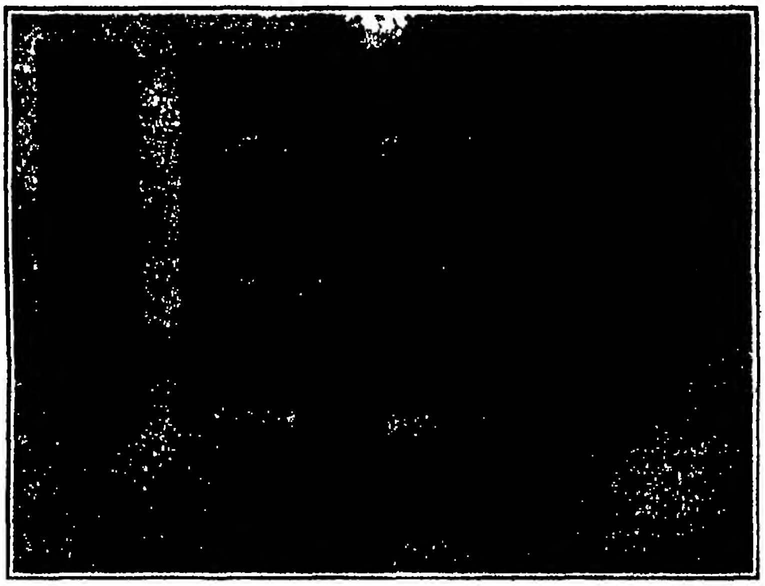
It is plain enough we think that with increasing skill in transmission and in interpretation at the receiving end this system is capable of very good results. The *Times* when it was able to do so through use of the mails, reprinted its telegraphed picture beside the original Discrepancies are easy to find Dempsey is recognizable, but the portrait is a bad one, his head projects too high, his right leg is too thin, the ropes are thin Carpentier's prostrate form departs from the true figure of the Frenchman as shown on the original, etc. But there could be no slightest doubt that the one is a reproduction of the other, and no reasonable claim that the telegraphed picture did not give a substantially accurate representation of the concluding moments of the big fight. We anticipate a lively future for the new process, especially in view of the fact that on this, the first attempt to use it, the picture was transmitted in fifty [illegible] in an hour and ten [illegible] up into a finished [illegible] by insertion of [illegible] and [illegible]

[illegible]

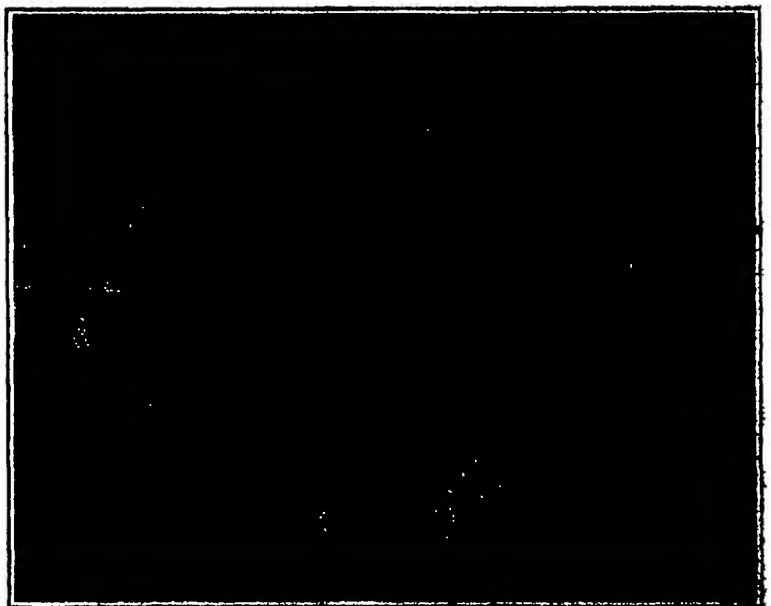
T[illegible] of [illegible] have [illegible]



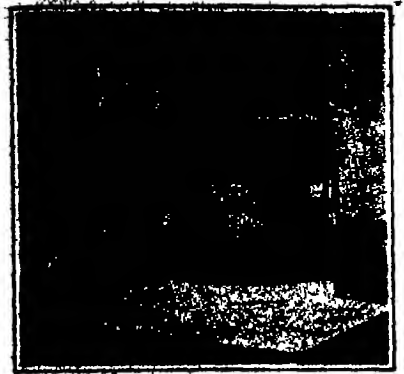
Inside and outside view of the lock in which the time elapsing between the several turns is an element in the combination



Orderly transportation of all the small accessories of the male apparel is here assured



Motion and temperature are combined here to give rapid drying



Electric-lamp tester for fast colors

Will Sunlight Fade Them?

HERE is a tester to demonstrate whether certain colors are truly "fast" when they come into conflict with the rays of the sun. Samples of cloth dyed various colors are put into receptacles and exposed to the rays of a powerful lamp that is rich in ultra-violet rays, such as the mercury vapor or arc. If after undergoing the test for fifteen minutes they retain the brightness of their hue, they pass the inspector.

The Traveling Service Station

ONE of San Francisco's large garages has equipped a number of light cars with special oil tanks and a cabinet that carries all kinds of grease and tools. The cars are driven to the customer's place of business and an hour spent in making adjustments, oiling and greasing the car, and testing and filling batteries. This service is given to the regular customers' cars once or twice each month, or oftener if necessary. Each traveling operator serves eight cars daily.

The traveling garage is equipped with two 15-gallon tanks, one for kerosene and the other for carrying cylinder oil. On the back of the car is a cabinet which carries hard-cut grease for filling universals and grease cups, a bucket of fluid grease, with a pump for delivering it, a drain bucket for draining and flushing crank cases; a battery-testing and battery-filling outfit, and compartment for waste. On the inside of the cabinet doors are brackets for oil cans and grease cups. The top of the cabinet is divided into sections for carrying all kinds of tools and wrenches. These sections are covered with a top that is also a creeper, which the operator uses when working under cars.

A [illegible] with clean hands!

The Drag of Zeppelin Airships

REPORT No. 117 of the National Advisory Committee for Aeronautics is a discussion of the results of tests with Zeppelin airships, in which the propellers were stopped as quickly as possible while the airship was in full flight. In this paper the author refers to the theory involved in these tests and to one scientifically interesting fact which can be derived from them and which has not yet been noted.

The chief general question concerning these tests is, of course: Does the negative acceleration of an airship with stopped propellers supply proper data for determining the drag of the airship when in uniform flight? This can not absolutely be answered in the affirmative, the two phenomena not being identical in principle. It is believed, however, that in this particular case the agreement is sufficient and that the data obtained from the test are the true or the approximate quantities wanted.

Garage service brought to your door

Door Knob and Bell Combined

BURGLARS and sneak thieves are prone to enter without taking the trouble to knock. A new mechanism, however, corrects this little oversight on their part, if they desire to come in by way of the door. As the knob turns, a lever is operated, communicating with a gong situated a few inches above the knob. The loud peals that issue are guaranteed to give the intruder a hint at least of the wisdom of thinking the matter over, before taking further action.

Shine Them with Electricity

AMONG the novelties exhibited at the recent electrical show in New York was the electrical bootblacking outfit illustrated at the left. The principle is, of course, the same as in many other familiar devices of more or less the same character, the steady patron of the dentist will surely recognize the flexible driving shaft. Like the barber's electrical massage outfit, the electrical shoe-shiner is mounted on wheels and is trundled about the floor from station to station. Its cost will probably give the lie to the photographer's enthusiastic caption "the human bootblack will soon be a memory," but at that it will presumably come into wide use.

Stresses in Ship Plating

MILD steel plates of rectangular area fixed along their edges or boundaries and subject to uniform fluid pressure are commonly met with in practice. There is, however, a lack of information to guide the designer in assigning dimensions, and the object of a recent paper by Dr. Bernard C. Laws reported in the London Times Engineering Supplement was to give some information on this subject.

He pointed out that the plating under the load suffers deflection, in consequence of which direct tension is experienced, affecting the resultant stress not only by virtue of its own value, but by the bending moment which it exerts on the material apart altogether from that resulting from the action of the direct load. At present the determination of stress is possible only by subjecting the plating to experiment and making a mathematical analysis of the derived data. It does not appear that any conclusive experiments have been carried out on stiffened or reinforced plates, and in only a few instances have free plate areas been so treated. Until comparatively recently Grashof's expressions afforded the only aid to designers, but it is realized that the results so obtained are wide of the truth. The author discussed the effect of fluid pressures on the ultimate stress in mild steel plates when considered jointly with the stresses induced in the material on account of local or structural bending of the vessel. He also dealt with the question of stiffened or reinforced plates, and in the absence of complete experimental investigation made an endeavor to trace the effect of the reinforcement in bringing about a redistribution of stress. The subject finds special application in the design of sea going vessels where the plating forming the skin of the outer or inner bottom and the diaphragm of watertight or oiltight bulkheads is called upon to withstand stresses due to fluid loads in addition to those resulting from bending moments.

A Precision Inclinometer

THE inclinometer has been little known until recently except to those who have had to do with airplanes. The army flyer knows it as one of the instruments on the dash of his plane that indicates whether he is ascending or de-

Turning the knob rings the bell

scending and at what angle, also at what angle his wings are banked for a turn.

An inclinometer has been recently placed on the market designed for use as a precision instrument in mechanical laboratories, machine shops and in building operations. It is a skilfully designed tool consisting of a carefully machined case of cast metal containing an accurately adjusted gear train driven by gravity impulse. The two dials on the instrument indicate degrees and minutes respectively, the hand on the degree dial moving in unison with the impulse, while the hand on the minute dial is driven by the multiplying gear-train, causing the latter to make thirty-six revolutions while the degree-dial hand makes one revolution. The multiplying effect of the gear train is such that the instrument gives angle readings direct in degrees and minutes with accuracy corresponding to that of a single-dial inclinometer having a dial approximately ten feet in diameter.

A very important and interesting feature of the design of the instrument is the means employed for overcoming the inaccuracy due to bearing friction. This is accomplished by mounting the bearings in rings which are concentric with the

Reading angles directly in degrees and minutes from the dial

pivots and which are connected with arms or levels extending outside the case. The levers are provided with knurled handles and in using the instrument, the operator moves first one handle and then the other up and down a few times, allowing the levers to strike against the ends of the slotted holes in the case. The combination of the hammer effect and the oscillating movement of the bearings around the shafts very quickly eliminates all retarding effect due to bearing friction and the hands of the instrument take a position that gives the true reading.

This inclinometer may be used for all purposes where the less accurate spirit level, plumb, or protractor is now employed, and aside from its greater accuracy, is a much more handy tool, as it indicates not only the vertical and horizontal, but all angles in between. For accurate inspection of angles it is a more usable tool than the sine-bar, as the angle is indicated directly, whereas with the sine-bar it is first necessary to set the tool and then go through a series of calculations before the reading is obtained.

Attaching the Stopper to the Bottle

THE bottle and the cork need never be separated if the method shown in the illustration be followed. As will be noted, the device consists of a piece of stout bent wire, one end partly looped about the neck of the bottle, the other thrust through the cork stopper. The looped end slides up and down the smooth glass surface, as required. This simple expedient is worthy of consideration by the chemist, physicist, or the woman who is averse to having her choice perfume spilled, especially on good furniture.

The stopper that stays with its bottle

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

AEROPLANE WING W E KNOELL, 609 South 36th St., Tacoma, Wash The principal object of the invention is to produce an aeroplane having wings supported entirely by wing supports extending from the fuselage, and with said wing supports positioned within the wings in such manner as to obviate the necessity of the use of struts and guy wires. Another object is to construct an aeroplane in such manner that the wing stress incident to flying will be transferred so that the leverage with respect to the fuselage is decreased.

AEROPLANE.—T A. MACDONALD, 208 Hampton Ave. Paterson N J The purpose of this invention is to provide an aeroplane in which a plurality of planes that normally function as lifting planes are capable of being manipulated to form a parachute for retarding a fall to the ground in the event of an accident, the parachute as a whole being capable of quick adjustment along the fuselage to occupy the most advantageous positions for retarding the fall to the greatest possible degree and of maintaining the machine upright during its gradual downward travel to the earth

Pertaining to Apparel

GARMENT PROTECTOR.—C. J KEPPEL, c/o Christian Flag & Novelty Co. Monroeville, Ohio. The invention relates to an article to be worn upon the person as a garment protector and has reference more particularly to a so-called child's bib and sanitary napkin. The primary object is to provide a substantially waterproof article which may be laundered without impairing any of its waterproof qualities and consists of a sheet of waterproof material adapted to be inserted between two sheets of cloth material.

MOCCASIN.—A F ORR Box 258 Lisbon Me. The invention relates to foot wear, and has for its object to provide a construction which will be strong and also neat in appearance, while obviating the usual puckered appearance found adjacent the front of a device of this kind. An additional object is to provide a construction wherein the vamp may be formed to extend nearly around the front part of the moccasin or entirely thereover including the uppers.

Electrical Devices

ELECTRIC BULLETIN.—R. E. JONES, 42nd Inft., Camp Gaillard, Canal Zone Panama. An object of the invention is to provide an electric bulletin whereby information in the possession of an individual may be disseminated among a large number of persons either by day or night, the characters on the bulletin board in either day or night operation being formed by the manipulation of a transmitter of the same construction.

ARTIFICIAL ILLUMINATION.—G H SHERINGHAM, 1 Clanricarde Gardens Bayswater, London W 2 England. The particular object of the invention is to provide a means whereby the quality of light derived from an artificial source, such as an ordinary incandescent electric light bulb, may be made to be substantially equal to daylight. The main object is to provide two reflectors, the upper reflector having its reflecting surface colored, and the lower being opaque and reflecting the rays of light on the upper or main reflector the entire surface of which is covered in small areas with methyl violet, ultramarine, and emerald green.

Of Interest to Farmers

HOPPLE.—E. E. HIGLEY, c/o Iron Creek Farm, Salmon, Idaho. Among the objects of the invention is to provide an animal hopple especially adapted for use with horses, which can be easily applied and removed, only by a person understanding its peculiar features of operation. Another object is to provide a hopple which plays easily around the leg of the animal above the hoof and which will not chafe or bruise.

CLEVIS.—W PORTER, Route No. 5 Aurora Oregon. The invention relates to a device used as a draft coupling in agricultural implements, vehicles or the like An important object is to provide a device which prevents the accumulation of dirt, sand and other foreign matter around the lock joint. Another object is to provide a pin and clevis device which is self-locking which will not be materially affected by the weather, which will be unlikely to catch on other working parts, and which is easily operated. (See Fig 1)

Of General Interest

LOCKING HOOK.—A. L. GEISLER, 29 Summit St. Bristol, R. I An object of this invention is to provide a device which may function either as a keyring, a coupling link, or a hanger In the form of a keyring it will prove amusing as a puzzle for children. A further object is to provide a locking hook which will be simple and practical in construction, and comparatively inexpensive to manufacture. (See Fig. 2.)

AIR COOLER.—W H STONE, Box 522, Port Angeles, Wash. The invention relates to an apparatus for cooling the air in a house or room during hot weather An object is to provide a device through which the air is compelled to take a circuitous path and pass through screens over cold water flows, and over saturated moisture-holding pads to cool the air, which finally escapes through an ice chamber and is directed to any desired point.

CLOTHES HANGER AND PRESSER.—MARION G MCNEELY Tulare, Calif. The purpose of this invention is the provision of a hanger which is adapted to support men's or women's suits in such manner as to effect a pressing of the skirt or trousers. It is also a purpose to provide a hanger which is adjustable to accommodate trousers and skirts of various lengths and to hold the same under tension to effect pressing (See Fig. 3.)

WALL CONSTRUCTION.—J M NADAL, Humacao, Porto Rico. An object of the invention is to provide a reinforced structure which will greatly reduce the cost of house building. A further object is to provide a construction either of the solid or hollow wall type which will be strong and durable and may be assembled rapidly and cheaply A further object is to provide a type of panel-shaped building blocks having grooved faces adapted to receive reinforcing rods.

MASK.—F M DESSART, 509 Metropolitan Ave., Brooklyn, N Y The invention has for its object to provide a mask which includes a body portion adapted to overlie the eyes and nose of the wearer, a sheet of material and a liner affixed to the upper part of the material forming the body portion of the mask, the material being extended beyond the lower edge of the liner and body portion whereby to provide an integral apron.

HOLLOW WALL CONSTRUCTION.—F HEATH, 1001 McCormick Bldg., Chicago, Ill. Among the objects of the invention is to provide a wall construction in which hollow blocks may be laid horizontally without exposing the voids in the blocks. The object is to provide mitered blocks so formed as to be used at the corners which alternate with blocks disposed vertically the construction being such that the voids are not only hidden, but the courses are locked together

ALKALI SALTS OF OXIDIZED PROTALBINIC ACID AND OF OXIDIZED LYSALBINIC ACID AS STABLE PROTECTIVE COLLOIDS FOR MERCURY COMPOUNDS.—DR. MARI. E. WOLVEKAMP, 485 34th St., Oakland, Calif. The foremost object of the invention is to provide pure colloidal mercury compounds in the dry state, of which the solutions may be boiled without precipitation of free mercury The invention relates to the alkali salts of oxidized protalbinic acid and of oxidized lysalbinic acid, obtained out of an albumin from egg albumin, or serum albumin, and their use as compounds for medical purposes.

PIPE COVER.—W L. GUY, 1206 Lincoln Ave., Alameda, Calif. This invention relates to a smoking pipe in which it is practically impossible for fire to escape or ashes coming from the pipe bowl to get into the user's eyes. The object is to provide a dome-shaped cover capable of being attached to the pipe by means of a ferrule, and having a draft tube extending longitudinally of the axis of the pipe bowl outside of the bowl. The cover may be easily removed for refilling or cleaning of the pipe.

MATERIAL FOR AND PROCESS OF FORMING BRICK TILE AND THE LIKE.—L. JONES, 923 Wheeling Ave., Muncie, Ind. The object of the invention is to provide a material of a nature capable of thorough cementation, under intense pressure, without the necessity of burning in a kiln, as is necessary with clay. A further object is to provide a means whereby a by-product of blast furnace slag may be utilized in forming bricks and tile in various shapes, impractical in a burnt brick on account of the warping and cracking during the burning process. The material contains silica 70 per cent, lime 25 per cent, magnesia 2½ per cent, sulfur 2½ per cent.

BROOM HOLDER.—S. CANTOR, 210 E. 31st St., New York, N Y The invention has for its object to provide a holder which is adapted for supporting a double-ended broom which permits the ready insertion or removal of the broom. A further object is to provide a holder of the character stated which can be manufactured and sold at a reasonably low price, which will be strong, and which will securely maintain the broom in operative position.

Hardware and Tools

WATER COOLING CONSTRUCTION FOR WELDING TORCHES.—J F GILBERT and T NEVILLE, P O Box 1006, Seward, Territory of Alaska. The primary object of the invention is to provide a water-cooling attachment which may be applied to a conventional type of torch without departing from or materially changing the original construction of the torch A further object is to construct the water-cooling attachment in such manner that water will be caused to circulate throughout the greater length of the torch, and thus realize effective cooling. (See Fig. 4.)

TOOL.—H. A. WEINSTEIN, 5418 Fourth Ave., Brooklyn, N Y The invention has for its object to provide a tool which is primarily designed to facilitate the adjustment of the needle valve on the carbureter of a well-known type of car, in which the needle valve is provided with a threaded stem having a tool-receiving slot in its upper end and a nut around the stem. A further object is to provide a tool which will be capable of simultaneously engaging both the nut and the slot to adjust the valve.

TAPER GRAB.—F L. CHRONISTER, 618 No. Blvd., Edmond, Okla. Among the objects of this invention is to provide a device of the character specified which may be instantly adjusted for different sizes of wire, rope or cable, and which will firmly grip the rope or cable, but which may be easily released when desired.

TOOL.—R. FAGAN, Box 27, Latimer Mines, Pa. The invention relates to tools used in connection with railroad rails. An object is to provide a tool which is simple and durable, which has a wide range of adjustment, and which permits of the bending of the rail in any one of four directions at any point throughout its length up to and within close proximity of its ends.

SHADE FIXTURE.—W MCNEALS, Box 351, Greensboro, N C. The invention has for its object to provide mechanism in connection with shade pictures for permitting the shade to be operated by means constraining the roller and reel to turn together when the reel is turned in one direction, and to disconnect the reel and roller when the reel is turned in the reverse direction.

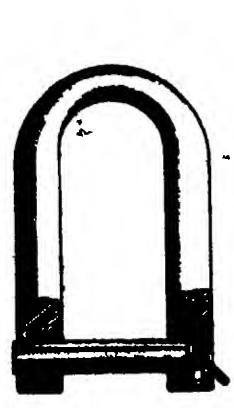


Fig. 1. An improved clevis for draft-animal coupling invented by W Porter

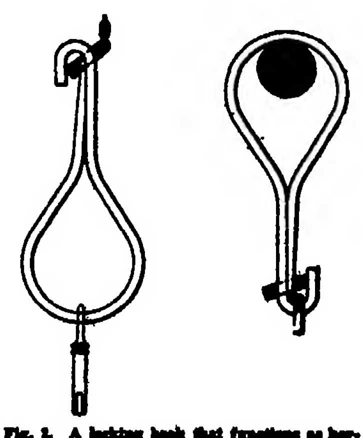


Fig. 2. A locking hook that functions as key-ring, coupling link, or hanger; invented by A. L. Geisler

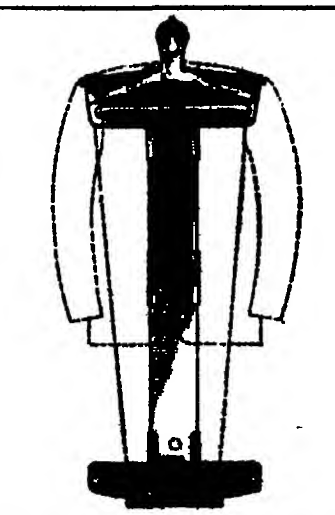


Fig. 3. A clothes hanger combining the functions of presser, invented by Marion G. McNeely

Fig. 4. A water-jacketed welding torch, of novel construction, invented by J. F. Gilbert and T. Neville

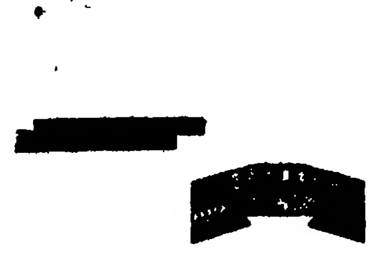


Fig. 5 The extension rule invented by F H Fenwirth, shown in horizontal and vertical section

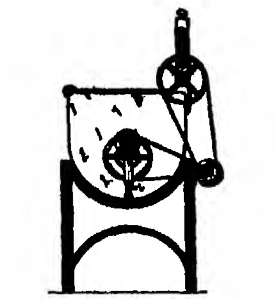


Fig. 6: The specially geared washing machine covered by two patents to F H. Mayer

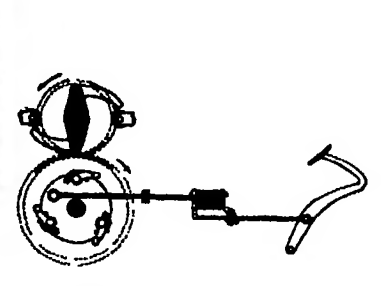


Fig. 7 The automatic clutch-pedal operated gear-shifting device invented by J Kirkeby

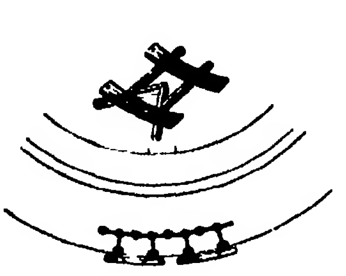


Fig 8: Anti-skid tire-chain of novel design invented by M L. Henderson

LOCKING HINGE OR CONNECTION.—F J DOWLING, 436 W 124th St., New York, N Y Among the objects of the invention is to provide a hinge or connector, comprising two plates or their equivalent, adapted to be secured to the door and jamb, respectively and so arranged that whether the hinge pin is used or not they will prevent the movement of the door in any direction with respect to the jamb except the door be first unlocked so that it may be swung or moved in its intended direction.

WRENCH.—A W MINNEY, 231 E. Freemont St., Stockton, Calif An object of this invention is to provide a wrench which is of simple and durable construction, which exerts a proper gripping action upon the work and which immediately responds to the control of the operator during the engaging, gripping and disengaging phases of its operation.

EXTENSION RULE.—F H. FENWIRTH 147 W 128th St., New York, N Y The invention has reference more particularly to an extension rule in which the elongation of the rule is obtained by moving the various parallel members composing the rule axially An object is to provide a rule which is adapted for measuring inside dimensions, and is so calibrated that the distance between inside surfaces may be laid directly on the rule. (See Fig. 5)

BUTT-HOOK.—C. VALA, Marshfield, Oregon This invention relates to hooks used for hauling logs when the log is engaged by a wire rope known as the choker The object is to provide a hook of the character specified which cannot become unfastened accidentally and which is not liable to become fouled with mud, brush and the like, and which may be readily attached and removed.

SOCKET WRENCH.—O J WILLIAMS, Orchard Park, N. Y The invention has for its object to provide a socket wrench having radially adjustable jaws which permit the wrench to accommodate itself to nuts of various sizes. A further object is to provide a readily adjustable mechanism which will be strong and durable, and not readily damaged in the ordinary course of usage.

CONNECTOR LINK FOR CHAINS.—W A. BROWN, Lincoln, Neb. The invention relates more particularly to separable links for use in connection with tire chains, although not limited to this purpose. The general object is to provide a link of the indicated type with means for locking the swingable elements in closed position, effectively preventing accidental separation.

TRAP.—W R. LAMBERT, Box 415, Hardin, Mont. The general object of the invention is to provide a steel trap with spring-actuated jaws adapted to clamp the foot of an animal. One of the principal objects is the provision of a trigger member constructed as an independent element which may be loosely attached to the anchor chain, but which is free to fall clear of the jaws as soon as the jaws have been sprung into closed position.

Heating and Lighting

HEAT DEFLECTOR AND DRAFT CREATING DEVICE.—A. J. ANDERSON, 9½ Spencer St., Ashtabula, Ohio. The invention has particular reference to a device to be placed over a burner on a liquid or gaseous fuel cooking stove to concentrate and intensify the flame. An object is to provide a device which is so constructed that the passage of flame will create a suction, drawing up air between the burner and the device, while air commingles with the flame and is conducted upwardly in the form of a concentrated intensified flame of great heat value.

STEAM CONDENSER FOR CLOTHES PRESSES.—J. ROTH, 817 Summit Ave., Jersey City, N. J. A purpose of the invention is to provide an apparatus to be installed upon any standard type of steam clothes press, and used with the press for the purpose of collecting the exhaust steam. A further purpose is to provide means for collecting the cold water condensation which forms in the pipe and again utilize it within the press boiler to prevent waste, and to prevent the hot steam from passing into the room.

METHOD AND APPARATUS FOR PRODUCING A REGULAR PROGRESSION OF MATERIALS IN VERTICAL OVENS.—J PIETTERS, 12 Rue de la Rochefoucauld, Paris, France. The invention relates to a previous patent granted to the same inventor, which consists of the use of a coke pusher traveling above the ovens to allow of exerting a very considerable pressure upon the upper portion of the coil. By the present improvement the material is compressed and forced to travel through the ovens and to be discharged therefrom, thereby permitting continuous vertical ovens to be discharged with at least as much ease as the discharging of ordinary discontinuous horizontal ovens, at the same time preventing the escape of gas.

TUBE CLEANING APPARATUS.—J H WHITE and E. J FRANKLIN, Hayden, Arizona. The invention particularly relates to an apparatus for removing scale, sludge or incrustants from the tubes or pipes of surface condensers, boilers, heaters, evaporators, coolers and like devices. An object is to provide means whereby either liquid, semi-liquid, or particles of solid matter are drawn through the tubes by suction or partial vacuum to effectually clean the interior of the tubes without damaging the same.

HOT AIR REGISTER.—J L. ELLISTON, Clinton, Mo.—An object of this invention is to provide a register adapted for use in connection with the so-called pipeless furnaces, the register having means for cutting off the view of the interior of the main conduit of the furnace from the room into which the conduit discharges, and in addition to cutting off the view give the register an appearance of strength

Machines and Mechanical Devices

NAIL DRIVING AND SETTING MACHINE.—A. RIVERA, 322 44th St., Brooklyn, N Y An object of the invention is to provide a manually operable machine for handling parquet nails, such as are commonly used in laying floors, and to provide means associated with the machine for automatically feeding the nails. A further object is to provide a machine which accomplishes the driving and setting operation at the same time, and which is, therefore, a great time-saver

PUMPING DEVICE.—G. K. LEIHY, 369 Gates Ave., Brooklyn, N Y The invention particularly refers to a simple and efficiently operated pump of the rotating type. An object is to provide a device which in a simple manner causes a constant flow of liquid through the pump as a result of an application of the centrifugal action taking place in the rotating receptacle. The pump requires a minimum amount of power, and is composed of a small number of parts.

COLLAPSIBLE CORE AND CHUCK.—P DE MATTIA, Clifton, N J This invention relates to collapsible cores and chucks for use in the manufacture of pneumatic tires. Its object is to produce a core and chuck so constructed that while affording an effective support for the tire while building up the carcass and the fabric into tire shape, it will permit ready disengagement of the built-up tire from the core with a minimum effort on the part of the operator and with a minimum distortion of the tire.

WASHING MACHINE AND GEARING FOR SAME.—F H MAYER, 234 Elate St., Denver, Colo. The inventor has been granted two patents relating to the same subject matter, one has for its object to provide a washing machine with a clothes cradle made of strong wire mesh but given a corrugated shape to produce a wash-board effect; the cradle has no interior rods or projections which would tend to cause the clothes to become entangled. The other invention provides for a mutilated drive gearing for oscillating the clothes cradle so as to wash the clothes and a continuous gear for revolving the cradle to expel the water therefrom (See Fig 6)

BOX GLUING APPARATUS.—O A LUCAS, Richwood W Va The invention relates to an apparatus for the gluing of pasteboard boxes, and has for an object the gluing in place of the covers of the boxes which after being placed on a platform, are held in engagement until the glue is dry The apparatus is adapted to operate on boxes of various sizes.

Medical Devices

DOUBLE CURRENT SYRINGE — J K MITCHELL, 921 Coward Place, Memphis Tenn This invention has for its object to provide a device of the character specified by means of which thorough irrigation may be had with thorough drainage, and wherein with the syringe in place in the cavity the irrigating solution may be permitted to waste or may be directed into the cavity through the spray head

Prime Movers and Their Accessories

PROCESS AND APPARATUS FOR IMPROVING COMBUSTION IN EXPLOSIVE ENGINES.—W W HALES and A. HINE, 109 William St., New York, N Y An object of the invention is to utilize the large quantity of heat represented by carbon monoxide in the exhaust gases of an internal combustion engine, by introducing ozonized oxygen or ozone along with the explosive mixture of fuel since ozone is a much more active oxidizing agent than atmospheric oxygen and therefore all the carbon monoxide will be completely burned to carbon dioxide with a result of increasing efficiency of the engine. The introduction of ozone will also prevent the formation of elementary carbon on the walls of the cylinders, the piston, and the spark plug

SPARK PLUG — R W MOORE, 706 Rialto Bldg St. Louis, Mo. An object of the invention is to provide a spark plug for internal combustion engines which may be quickly and conveniently cleaned without the use of tools, while the same is installed upon the cylinder of the engine, and without separating the elements of the spark plugs.

FUEL HEATER FOR INTERNAL COMBUSTION ENGINES —L. A. COUCH 530 W 186th St. New York, N Y The foremost object of the invention is to provide a simple electrically operated fuel heater, which consists principally of a wire resistance disposed across the current of carbureted air for the purpose of heating this air before it enters the intake manifold. A further object is to provide an electric resistance the wires of which are so fine that the flow of air will not be impeded.

Railways and Their Accessories

SUPERHEATER —W G LANDON, 60 Broadway, New York N Y An object of the invention is to provide a superheater for locomotive boilers and the like in which the steam-carrying elements are located in the fire box above the brick arch and connected with headers outside of the boilers and provided with automatic damper controlling mechanism which admits air to the space occupied by the superheater when the throttle is closed and the steam-carrying elements are empty, to prevent injury to the elements by the heat of the fire box

SAFETY BRUSH BRAKE FOR RAILROAD MOTOR CARS.—S. C TANNER, Relay, Md The invention relates more particularly to cars utilized for various purposes, including the inspection of railway lines, the invention being applicable alike to manually propelled cars as well as gasolene cars, which are of light weight as compared to other railway rolling stock, and easily derailed by stones and other small articles. The device may be utilized to clear the tracks of small obstructions, and may be used as a brake when stopping the car

Pertaining to Recreation

TOY RAILWAY —C F EDWARDS, 36 Waverly St. Ottawa Ontario Canada. Primarily the invention aims to simplify the commercial manufacture of miniature toy railways, whereby to permit of a substantial reduction in size without weakening or detracting from the durability or attractiveness of the toy and to overcome the common tendency of the cars to jump the track by providing a form of supporting wheels, and a roadbed with which the same will coact.

Pertaining to Vehicles

ANTISKID DEVICE. O S PULLIAM 29th floor Singer Bldg New York N Y The primary object of the invention is to provide a device for use with wheels of motor vehicles which is permanently attached to the wheel and is movable into and out of operative position with the tire or traction surface of the wheel Another object is to provide means by which the traction increasing elements are locked against movement in both their operative and inoperative positions. The device may be used with pneumatic tires without injury to the tire in any way

TRANSMISSION —O S PULLIAM 29th floor, Singer Bldg New York N Y The invention relates more particularly to a driving mechanism for vehicles of the self-propelled type. The primary object is to provide a driving mechanism for motor vehicles in which various speeds may be obtained without the use of the transmission mechanism commonly employed A further object is to provide means for supporting the propeller shaft in such a manner as to permit of the foregoing operation.

AUTOMATIC GEAR-SHIFTING DEVICE. J KIRKEBY 1142 Sycamore St. San Luis Obispo, Calif The invention is designed more particularly for use with automobiles of the class using sliding gear speed changing transmission its principal object is to provide means whereby a predetermined change can be made by the action of the clutch pedal controlled by a dial or the like. Another object is to replace the shifting lever now in use with a mechanism connecting directly with the shifting rods, or forks where the shifting rods are incorporated in the cover of the transmission. (See Fig 7)

DIRECTION INDICATOR FOR MOTOR VEHICLES.— T A BRETT Pittsburg Calif An object of the invention is to provide a means by which the driver of a motor-driven vehicle can conveniently indicate to the driver of any other vehicle traveling in the same or opposite direction the fact that he wishes to stop or turn to the left or right. The device indicates the course to be pursued in front as well as in the rear, the device being actuated by simple mechanical means.

TIRE CHAIN — M L. HENDERSON, c/o Old Faithful Ranch Moore Mont. The invention has for its object to provide a chain which is easily applied and detached, and will hold the wheel from slipping in any direction. The chain is composed of a series of links each of which consists of a pair of plates spaced apart from each other and adapted to extend transversely of the tire and connected by an open framework of cleat bars, whereby the tire will not be injured as a result of continued use. (See Fig 8.)

TRACTION WHEEL.— G. H SCANLAN 292 Fulton St. New York, N Y The invention relates to a wheel capable of use on tractors or other power devices and vehicles, and has for its object the provision of a construction wherein a comparatively wide and long base is provided at all times so as to support the parts on comparatively soft ground. Another object is to provide a wheel which utilizes pivotally mounted shoes and means for holding the shoes in position so as to engage and also leave the ground readily

Pertaining to Aeronautics

DEVICE FOR COOLING THE MOTORS OF AIRPLANES OR DIRIGIBLE AIRCRAFT.—H. R. Guyot, 34 Avenue Jean Jaures, Paris, France. The invention relates to a cooling device the arrangement of which effects in a simple and certain manner the internal ventilation of the shell or casing of the apparatus used for aerial navigation, airplanes, dirigible balloons, etc., and also effects the perfect cooling of the motors for such apparatus, by permitting the utilization of the direct action of the speed of the airplane to cause the hot air inclosed in the chamber of the motor to circulate

Pertaining to Apparel

SOFT COLLAR FASTENER.—L. Reiter c/o Rau Fastener Co., Providence, R. I. The object of this invention is to provide a collar fastening device which combines with clamping means small spurs which function to engage the inner side of the collar wings and anchor the device to the collar without tearing or otherwise defacing the outer surface thereof. A further object is to provide a fastener which is easily associated with or removed from the collar

Electrical Devices

STEAM WALLPAPER REMOVER.—A. W. Tucker, c/o Tulsa Hotel Tulsa, Okla. The object of the invention is to provide a steam wallpaper remover which is self-contained and of simple and unitary construction which electrically generates its own steam in a convenient and entirely safe manner, which applies the steam to the wallpaper so that the steam permeates, softens and loosens the same to effect the complete removal thereof

PNEUMATO-ELECTRIC SWITCH FOR MUSICAL INSTRUMENTS AND THE LIKE.—A. H. Williams, 2817 W. 44th St., Minneapolis, Minn. The foremost object of this invention is to provide a pneumato-electric switch to be used in operating musical instruments such as organs, pianos and the like. The device is not limited to the application to organs having no keys, but is also adapted to instruments having a pneumatic player action.

LAMP.—G. E. Villamy, 1652 University Ave., New York, N. Y. The invention relates more particularly to electric lamps, an object being to provide a lamp which employs but a single electric bulb and which functions to illuminate the room as well as give forth a diffused light for reading. A further object is to provide a table lamp in which the light from an incandescent bulb is deflected upwardly to illuminate the room and diffused downwardly to prevent glare to the eyes of those seated.

HEATER.—L. A. Taotikos, 416 Greenwich Ave., Greenwich, Conn. One of the principal objects of the invention is to provide an electrical heater especially designed for warming confection batches, the same including means for regulating the degree of heat and controlling the projection of the heat rays to concentrate them upon the batch while working the same. A further object is to provide a portable heater which is simple and inexpensive.

ELECTRIC RAZOR.—J. A. Hammond, 210 So. Granite St., Deming, New Mexico. Among the foremost objects of the invention is to provide a concave razor of the ordinary straight blade type, with electrically operated means for giving the blade a swinging cutting stroke in contradistinction to the parallel or "chopping" stroke which is characteristic of electric razors in common use. A further object is to provide a razor wherein the operating mechanism is so incased in the handle as to present a graceful appearance.

AUTOMATIC CALL SYSTEM FOR HOTELS.—A. H. Heyroth, address H. W. Coulter, care U. S. Electric Products Corp., Duluth, Minn. An object is to provide a call system which may be readily applied to an ordinary telephone system so that the same circuit wires can be used for the two purposes. A further object is to provide a system which embodies a master clock, whereby the call apparatus may be set for calling the guests at predetermined times, and whereby the called guests can cut off the signal, or whereby the guest can signal to the clerk

CIRCUIT CONTROLLING TELEPHONE RECEIVER SUPPORT.—J. B. Fumbs, Union Bldg., Newark, N. J. This invention relates to desk telephones. The object is to control the switch mechanism by an extensible receiver support of the lazy tongs type and carrying a receiver at its outer end, the receiver support when in folded position opening the telephone circuit and when moved into extended position closing the circuit for the transmission of messages.

FLASHLIGHT.—J. Vinci, 429 78th St., Brooklyn, N. Y. The invention particularly relates to a portable flashlight in which conductor means is provided, associated with the battery and independent of the shell to be insertible and removable with the battery, as distinguished from a conductor strip on the shell at the interior and which is likely to be damaged by removal of the battery especially when the latter "freezes" to the shell.

Of Interest to Farmers

APPARATUS FOR TILLING THE SOIL.—C. C. Cook, c/o Rividge Land & Navigation Co., Stockton, Calif. The invention has reference more particularly to an apparatus which has a rotating element adapted to dig a trench, cut up vegetable growth, and then return the soil to the trench. An object is to provide an apparatus in which the weeds, cornstalks and the like are first pressed flat to the ground, are then cut into pieces, a trench dug and the loose soil from the trench with the fragments again thrown back into the trench

CALF WEANER.—F. Schmidt, Swanwick, Ill. This invention has for its object to provide a device which is of extremely simple and light weight construction, and easy and inexpensive to manufacture and which will not work injury to the animal and is entirely humane in all respects, although effective in use. The device, which is in the form of an aluminum mouth-plate, is supported by the nostrils of the animal.

ATTACHMENT FOR TRACTOR WHEELS.—E. L. Polansky, R. No. 1 Box 6, Munden, Kans. Among the objects of the invention is to provide an attachment adapted for tractor wheels of any character as, for instance, binders and the like, wherein the wheel carries a series of cleats or spurs capable of being extended beyond the rim of the wheel, and normally spring held in retracted position, with means operable from a distance, for moving the cleats into operative position at any part of the wheel which is engaging the ground.

KICKING BOOT.—W. Nelson, R. F. D. No. 2, Walcott, N. Y. An object of the invention is to provide a device which can be readily secured to the hind leg of a cow to prevent kicking. A further object is to provide a boot comprising a splint extending across the joint and at the front of the rear leg of the cow and provided with an arrangement of straps which are passed around the rear of the joint and secured to effectually maintain the shield or splint in position to prevent the use of the leg for kicking.

Of General Interest

TWINE HOLDER.—W. and W. A. Crabtree, 1726 Highland Ave., Portsmouth, Ohio. The invention has for its object to provide a holder wherein bags of various sizes may be stored to be withdrawn when desired for use wherein practically all the space within the holder is utilized to the best possible advantage, and wherein both twine and the various sizes of bags are accessible from either side of the holder

SPRAYING NOZZLE.—W. Lange, Tannersville, Pa. This inventor has been granted two patents of a similar nature, the object being to provide a spraying nozzle designed for use in connection with refrigerating apparatus and the like and arranged to insure a thorough spraying of the hot water or other liquid into the air to effect a rapid cooling of the water for re-use in the apparatus. Another object is to permit of readily adjusting the nozzle with a view to spraying the liquid in either fine or coarse mist, and to provide a nozzle which is very simple and not liable to get out of order

FLUE SCRAPER.—E. Arm, 216 State St., St. Joseph, Mich. This invention relates to the flue scrapers of the kind used in connection with boiler flues. The general purpose is to provide a scraper having interchangeable parts, many of them alike, and thus admitting of standardization, the various parts being so arranged that in the complete device they constitute a scraper having considerable flexibility and adaptability, together with a high degree of efficiency

POCKETBOOK AND THE LIKE.—L. Langlie, 1921 La Fontain Ave., Bronx, N. Y. Among the objects of the invention is the provision of a construction wherein the usual folding or accordion effect is produced at the ends of the pocketbook while the amount of high-priced leather is reduced. Another object is to provide a pocketbook of substantially the usual appearance, but with folded end members independent of the center or body part.

CONVERTIBLE FURNITURE.—T. Hanley, East Norfolk, Mass. The object of the invention is to provide a piece of furniture of the character specified, which may be quickly and easily converted into a sofa, into a crib having side and end walls, or into a couch bed, and which when in normal position will be ornamental, and will differ but slightly from the usual type of sofa or settee.

ATTACHMENT FOR CHILDREN'S CARRIAGES.—F. Perrin, 121 14th Ave., Astoria, L. I., N. Y. The primary object of this invention is to provide an auxiliary seat for children's carriages which is adapted to be readily attached to the carriage and move therewith. It is a further object to so construct the device that the carriage to which it is attached will not be subjected to undue strain due to the carrying of the extra passenger

CALENDAR.—A. J. McDade, 416 N. Y. World Bldg., New York. The general object of the invention is to provide a perpetual calendar of the type in which separate adjustable means are provided for displaying, respectively, a day of the month, the name of the week-day, and the name of the month, and notably with respect to the means for displaying the day of the month prominently.

PRICE TAG HOLDER.—A. H. Newton, 947 Reliance St., Beaumont, Texas. This invention has for its object to provide a device of the character specified adapted for connection with the hangers of garments for carrying a tag with data thereon concerning the garment carried by the hanger, and which may be easily attached to the hanger.

BED SPRING AND AUTO CUSHION.—A. F. Sturm, Nehawka, Neb. Among the objects of the invention is to provide a supporting spring arranged to obtain a maximum of resiliency and cushioning effect, and wherein means are provided in connection with the main spring, in the form of auxiliary springs at the top of the main spring, for holding the main springs in proper relation with respect to each other while at the same time permitting them to yield laterally

ELASTIC AUTOMATIC ADJUSTABLE BLASTING SHELL.—R. L. Bowman, R. F. D. No. 5, Knoxville, Tenn. The invention relates to shells for blasting in coal mines, rock quarries and the like. The object is to provide a shell of such character that all the requirements of the coal miner or other user are met, and whereby any differences in the size or depth of holes or the amount of powder needed for a certain shot are automatically arranged for in the construction of the shell.

MEDICAL COMPOUND.—J. H. McDavid, 636 E. 42nd St., Chicago, Ill. The object of this invention is to provide a compound especially adapted for use in the treatment of neuralgia, to be used externally. The compound is composed of the following ingredients: black gun-powder, chloroform, beef-gall, and alcohol. The compound may be used in the same manner as a liniment on any part of the body

PENCIL ATTACHMENT.—H. W. Owen, 515 W. 41st St., New York, N. Y. This invention relates to attachments for pens and pencils and pertains particularly to a device adapted to support one end of the pen or pencil to which it is attached out of contact with the desk or table upon which the pen or pencil may rest. The primary object is to construct a device which may be attached without changing the construction of the pen or pencil.

PORTABLE HOUSE.—M. Blai, 1654 W. 21st St. Place, Chicago, Ill. An object of the invention is to provide a portable building which when assembled does not look like a portable building but like a building of regular construction, by joining the different units together in such manner that the joints are not noticed. The units are designed to interlock one with the other, so there is necessitated very little bolting of the different sections which may be quickly assembled, and the inner and outer walls provide a dead air space.

PIN TICKET.—C. F. White, 536 W. 111th St., New York, N. Y. Among the objects of the invention is to provide a ticket which may be applied to a garment in such manner that it is necessary to destroy the ticket in order to remove the same; a further object is to provide a ticket in which the pointed ends of the pins are concealed and covered so that one handling the garment is in no danger of scratching his hands.

COMBINED ANKLE STRAP AND ARCH SUPPORT.—A. Posner, 140 Bushwick St., Brooklyn, N. Y. The invention relates to supports for use as an insert in shoes arranged to simultaneously hold up the arch and brace the ankle, and to prevent the foot from moving within the shoe thereby giving the desired comfort to the wearer especially when walking. An object is to combine an ankle stay and arch support into a single unitary structure.

TANK.—J. R. Fletcher, address [illegible] Co., 911 1st Ave., Asbury Park, N. J. The invention is primarily intended for use in connection with a blow-torch by means of which the fuel will at all times be fed to the burner as long as any appreciable amount remains in the tank, a further object being the provision of an adjustable supporting member which will permit of the burner nozzle assuming an inclined position without danger of the tank overturning.

ARTIFICIAL HEDGE, LAWN AND SIMILAR ARTICLE.—R. W. Tenney, Brunton Studios, Hollywood, Cal. The object of the invention is to provide an artificial hedge, lawn or similar article for use in stage settings or for camouflage purposes. Another object is to provide an exceedingly strong and durable structure which can be readily moved about. Another object is to permit of the manufacture of the article at a comparatively low cost.

METHOD OF CASTING.—W. Leary, 309 E. 77th St., New York, N. Y. The invention relates to a method of casting whereby a metallic member in the process of being formed is rigidly secured to an already formed member, the connection embodying strength and firm gripping qualities, so that the one member would not eventually become detached from the other. It is primarily intended for use upon high class receptacles such as accessories, etc.

INSECTICIDE.—A. Constantin, 616 E. 17th St., New York, N. Y. This insecticide is especially valuable in the extermination of bedbugs and other house pests. The object of the invention is to provide an insecticide which is highly poisonous to insects, and when placed in an infested region will remain in place for long periods of time without being blown away or becoming detrimental to the health of human beings. The ingredients are as follows: Lard 3 parts, soap 1 part, yellow paint powder 1 part, and green paint powder 1 part.

TOOTHBRUSH.—C. R. Carroll, Newport, Texas. The invention relates more particularly to the double-headed type of brush adapted to clean both sides of the teeth and the margins of the gums at the same time. An object is to provide a construction wherein a slight rotary motion of the two halves of the brush may be effected to bring the pressure on the tips along the gum margins, where perfect cleansing is most to be desired.

CHECK PROTECTOR.—J. J. O'Brien, address Seward Shanahan, 44 Court St., Brooklyn, N. Y. The invention aims to provide a check protector which will primarily be of such a simple construction as to permit of its being placed upon the market at a nominal figure. A further object is the construction of a device which shall be extremely light and compact so that it may be carried in the pocket, that a check may be marked to prevent the amount being raised or the written matter otherwise altered.

COPY HOLDER.—A. M. Woodruff, 461 Hudson St., New York, N. Y. The invention pertains more particularly to a device for supporting in a visual position stenographers' note-books or other copy. It is the primary object to provide a copy-holder, with a marker movable with respect to the copy carried, and means by which the movement of the marker may be adjusted to steps of various lengths.

NON-SLIP DEVICE.—J. G. Zertuche, address Ruben Zertuche, 535 W. 112th St., New York, N. Y. The invention relates to a device comprising a suction cup which when in use is secured to an article of footwear for man or horses, the cup being sustained inverted in a manner to present its open side to the ground for collapsing under imposed pressure and effecting a holding action on the ground to prevent slipping, said cup having a vent opening automatically, closing under pressure and opening when the pressure is released.

ALLOY.—H. Emery, 1449 West Farms Road, Bronx, N. Y. An object of the invention is to produce an alloy capable of taking a high polish, having a high tensile strength and elasticity, which is non-corrodible and impervious to the action of acid, dilute or concentrated acids, such as sulfuric, tartaric, citric, oleic, oxalic, formic, as well as alkalis, sea water, and atmospheric influences. The alloy contains copper 35-40 per cent, nickel 30-40 [illegible], chromium 6-12 per cent and iron 25-37 per cent.

LEAK-PROOF JOINT.—H. W. Wessel, 59 W. 30th St., Bayonne, N. J. The invention relates to covers for containers, heads of boilers, stills and other apparatus. The object is to provide a [illegible] [illegible]

[illegible]

series of lapping leaves capable of extension and contraction in such a way as to avoid the necessity of inserting leaves within and removing the same from their proper places in tables as at present used.

BROOM.—S. CANTOR, 310 E. 51st St., New York, N Y The invention more particularly relates to double-ended brooms which are capable of reversal so that both ends may be used and thus result in economy to the user An object is to provide a double-ended broom having an arrangement of corn or straw whereby the smaller ends are at the outer end of the broom, and the thicker ends at the intermediate portion, where they are clamped together and contracted to give the desired flare at both ends.

Machines and Mechanical Devices

AUTOMATIC GAGE.—O DEL. BRAINARD, 210 Second St. No., Great Falls, Mont. This invention relates more particularly to gages designed to be used on linotype saws, an object being to eliminate as far as possible the necessity of hand work in spacing matter to fit ruled book headings and the like. A further object is to provide a gage which can be used in connection with any ordinary type of linotype saw, and give more accuracy than is possible under ordinary methods.

DEEP WELL PUMP.—S. CASSINA, 319 New York Ave., Brooklyn, N. Y. The invention has for its object to provide a construction for pumping liquids from great depths or to great heights. A further object is to provide a pumping apparatus in which the lifting medium is compressed air, with the parts so arranged that a comparatively low pressure and large vacuum will operate to lift the liquid to any desired height from a low altitude to a high altitude.

TEXTILE-FABRIC TREATING MACHINE.—L. CLARENBACH, 159 Hamilton Ave., Passaic, N. J The invention relates to machine for treating in liquids textile fabrics in open width or in the form of strings or ropes and has for one of its objects to provide a construction wherein dyeing and scouring and other treating of the fabric may be carried on rapidly and uniformly Another object is to cause the treating liquid to quickly and evenly penetrate the fabric.

FLOTATION MACHINE.—L. D. LYONS and C. F HOFF, 35 Missoula Ave., Butte, Mont. The invention has particular reference to the recovery of valuable minerals from their crushed ores, the object being to provide a machine which is equipped with floating froth gutters and an automatically controlled weir gate. The process is especially adapted for minerals of the sulfid type, where the preferential action of the air bubbles on the valuable minerals contained in the pulp is especially marked and causes a very complete separation.

FIBER EXTRACTING MACHINE.—W O LAMBERT and G. H. POUND, 701 Texas St., El Paso, Texas. The invention more particularly relates to that class of machine employed in connection with the separation of fiber from "agave" and other vegetable matter and leaves, for use in the manufacture of rope and cordage. One of the primary objects of the invention is to produce a machine which will adequately treat both sides of the agave leaf or other plant to insure the positive removal of all pulpy matter from the fiber so that the fiber will be thoroughly cleansed and in marketable condition.

DRILL HEAD FOR WELL DRILLING APPARATUS.—S. C. GILTNORE, 4517 Chestnut St., New Orleans, La. An object of the invention is to provide a well drilling apparatus for oil or gas wells which includes means for constantly playing streams of water on the cutting elements in order to minimize the danger of fire which might be generated by sparks due to contact of said elements with rocks or other solid substances. A further object is to provide a drill head which is insertible through and removable from a well casing without the necessity of removing the casing.

PISTON RING.—W D. MATHEWS, Marietta, Mich. The object of the invention is to provide a ring which will be proof against leakage in every direction. The piston ring comprises two similar sections, each having a diagonal gap, the gaps being opposite in the assembled ring, each circular section including an outwardly extending flange having its greatest thickness opposite the gap of the other section and tapering gradually toward both ends, the ends terminating short of the gap, and an inwardly extending radial pin on each section, the sections being recessed for the accommodation of the pin.

COMBINED PRESSURE REGULATING AND GOVERNING APPARATUS.—J. F. [illegible], c/o The [illegible] Co., Lyndhurst, N. J. The invention has for its object to provide a fluid pressure regulator in which a diaphragm controls the action of a main valve designed to maintain a predetermined pressure of the fluid passing through the regulator irrespective of boiler or initial pressure. Another object is to allow the regulator to deliver steam or other fluid to an engine, for instance, at a predetermined pressure.

MACHINE ELEMENT.—G C. WEISS, Box 148, Oakland, Cal. The general object of the invention is to provide a combination of machine elements It has reference more particularly to a mechanical movement for realizing a so-called compound tumbling or revolving motion. The invention is so constructed that it may be used in various devices, for instance, in washing machines, concrete mixers, churns, and different kinds of tumblers.

BOTTLE CAPPING MACHINE.—G. C. and W F ADAMS, 3852 19th St., San Francisco, Calif The object of the invention is to provide an inexpensive and simple device by which crimped caps or corks may be firmly pressed on bottles so as to make a good air-tight connection. The bottle to be capped is placed below a plunger and the cap interposed. A pressure on a lever will cause the plunger head to firmly press the cap over and around the top of the bottle.

DISH WASHER.—A. H HOCK, 31 Rogers St., Bluefield, W Va. The invention has for its object to provide a device especially adapted for family use, wherein a container is provided for the water, and a second perforated container for the dishes, and having means for rapidly oscillating the same for forcibly driving the water through the perforated walls of the inner containers, and means for limiting the movement of the dishes with respect to the oscillating container.

Prime Movers and Their Accessories

SPARK PLUG.—J S. COYLE, 836 University Club Bldg., St. Louis, Mo. The primary object of the invention is to provide a spark plug in which the terminals are movable with respect to one another to prevent the accumulation of soot and carbon thereon. It is a further object to construct the device in such manner that the electrodes are movable with respect to each other by means of the piston of an internal combustion motor

Railways and Their Accessories

CIRCUIT CONTROLLER FOR TRAIN CONTROL APPARATUS.—J G FERRIS, McLean, Va. A purpose of the invention is to provide a circuit controller comprising a contact wheel, a rockable rail, and means urging the rail toward the contact wheel to produce a scraping contact as the wheel passes, thereby effecting the removal of foreign matter, such as snow or ice, from the contacting surface to insure a good electrical contact.

GREASE CUP.—T C. DAVENPORT, 240 Lombard St., New Haven, Conn. The invention relates to grease cups more particularly adapted for use on locomotive side rods. An object is to provide a grease cup in which, after the engine is running, the grease will warm and flow, but the cup will not become lost due to the vibration or motion of the side rod.

SAFETY SCALE-PROOF AUTOMATIC GAGE COCK.—L. WHIPPLE and E. ONEAL: address J Oneal, c/o N. & S. Freight Office, Shreveport, La. This invention has special reference to that class of gage cocks using multiple valves and which are adapted to be used in connection with locomotive boilers. An object is to provide a separable gage cock to admit of the main valve and stem being removed for regrinding and other repairs without removing the entire assembly from the boiler, or withdrawing the steam.

RAIL LUBRICATOR NOZZLE.—J M. RIDDLE, Alamogordo, N M The invention relates to railway track lubricators and has reference more particularly to a rail lubricator nozzle of elliptical shape provided with spreaders so arranged as to insure the proper spraying of the rail with water when the railway car is rounding a sharp curve, thus presenting a clean track for the cars which follow the locomotive.

Pertaining to Recreation

STEEL FISHING ROD.—H. R. RAWSON, 536 Lake Shore Drive, Chicago, Ill. Among the objects of the invention is to provide a steel fishing rod comprising a plurality of sections of various lengths relatively arranged in such a manner that the weight and resistance in a rod of given size are distributed to afford the desired flexibility and balance, with ease of handling.

TOY BUILDING BLOCK.—W S. SHIELDS, R. F.D. No. 1, Yardley, Pa. This inventor has been granted two patents of a similar nature. Both relate to toy building blocks, and have for their object to provide a block by means of which many different articles may be constructed, merely by connecting the blocks with each other, as, for instance, building vehicles, aerial and marine, as well as many different devices without the necessity of any means other than the blocks themselves for making the connection All the tongues and bars of the blocks are flexible, and the arrangement permits the dove-tailing of the blocks together

Pertaining to Vehicles

DIRECTION INDICATOR.—M T McINTYRE, c/o Gooch Milling Co, Lincoln, Neb. The primary object of the invention is to provide a device of the character mentioned which may be readily attached to and detached from motor vehicles without materially changing the structure of any part of the vehicle. A further object is to provide a device which will be illuminated whereby it may be seen at night, and so constructed that the light will be automatically turned on when in display position and turned off when hidden

AUXILIARY AIR FEED.—P E KLINE, 643 Dewey Ave, Bridgeville, Pa The invention relates to auxiliary air feeds used upon internal combustion engines, and applied more particularly to such internal combustion engines as are used upon automobiles, the particular purpose being to increase the efficiency of the air feed of the engine. The device can be adjusted with extreme nicety so as to admit any desired quantity of air over and above that which is always supplied by the carbureter

REVOLVING BOTTOM DUMP WAGON.—E. G LEONARD, 1125 S. Prairie Ave., Sioux Falls, S. D. An object of the invention is to provide a dump wagon in which the bottom is arranged to revolve, thereby leaving the load in a compact heap Further objects are to provide a device of this type in which the revolving bottom may be held stationary to act as a leveling device in grading roads, and in which the end is positively locked, but may be unlocked instantly to permit dumping

LOADING AND UNLOADING DEVICE.—J DYER, 5560 Ardmore Ave, Chicago, Ill An object of this invention is to provide a device that can be readily detachably applied to an automobile truck or to other supports whereby lumber or similar material can quickly be loaded upon or unloaded from the automobile truck or supports to which the device is applied. A further object is to provide a device which can be operated by hand

RIM CONSTRICTING AND EXPANDING DEVICE.—J L. KALTREIDER and C F SHRYOCK, 558 York St., Hanover, Pa The invention relates to devices for constructing rims to allow the ready removal of the tire and for expanding a rim to effect a perfect seating of the tire. It is a purpose of the invention to provide a device which is of simple construction and easily operated in one direction to effect a constriction of the rim, and in another direction to expand the same.

AUTOMOBILE SIGNAL CASING.—S. GOLDSTEIN, 10 Stuyvesant St., New York, N Y This invention has reference to a signal to indicate to a vehicle in the rear the direction the vehicle in front is about to take in turning as well as a "stop" signal. The general object is to provide a signal in which convenient access may be had to the parts for examination, repair or removal The signal is visible to those approaching at an angle as well as those directly in the front or rear

STEERING MECHANISM FOR TRAILERS.—G E CONRAD, Box 55, Stillwater Minn An object of the invention is to provide mechanism adapted for connection with the guiding wheel of a trailer, and so arranged that the guiding wheel will be swung by the turning of the power vehicle to constrain the trailer to follow the power vehicle, and having mechanism for locking the guiding wheel in straight position, normally releasable and operable from the power vehicle

VEHICLE WHEEL.—H D RAY, Avarua, Island of Raratonga, New Zealand The invention has for its object to provide a wheel especially adapted for vehicles, but suitable for wheels of any character, wherein the spoke portions of the wheel are arranged between holding means on the rim and holding means on the hub, the holding means being adjustable to tightly clamp the spokes in place

AUXILIARY TREAD ELEMENT FOR VEHICLE WHEELS.—R. S. HOWARD, 145 Hudson Ave., Red Bank, N J The general object is to provide an attachment for the wheels of automobiles and trucks adapted to be applied to the wheel at the rim and present a lateral annular flange to constitute an auxiliary tread radially inward from, and at a side of the tire, so that when the vehicle encounters soft ground and the wheel sinks to the wheel rim the auxiliary tread will be brought into action

TRACTOR.—J C. WOOLEY, University of Missouri, Columbia Mo. The invention relates to self-propelled vehicles, and has particular reference to means for maintaining level the frame of the vehicle by the medium of eccentrics within the running wheels, for this purpose means are provided to turn the eccentric bearing elements of the two tractor wheels, in opposite directions, for maintaining the frame of the tractor level, when the same is traveling upon a hillside.

FAN.—L. H SOHN Huron, So. Dak. This invention has for its object to provide a fan especially adapted for use with motor vehicles, the fan blades being adjustable to vary the inclination of the blades with respect to the axis on which the fan rotates. To permit the fan to be adapted for different weather conditions, mechanism is provided for permitting the fan to be adjusted from the seat of the vehicle.

MOTOR SLEIGH.—G BROWNLEE, 1080 Richmond Ave, Victoria, B C., Canada The invention relates more particularly to a vehicle for traveling over ice or snow The principal object is to provide a running gear which particularly fits the same for travel over uneven surfaces, with the transmission of a minimum amount of shocks and jars. Another object is to provide means operable from the driver's seat for controlling and regulating the engagement of the traction elements with the ground surface in order to obviate the necessity of cutting off the motor when it is desired to bring the vehicle to a stop.

SCOOP BOARD.—W J COMBS, Box 24 Otterbein Ind. An object of the invention is to provide a board especially adapted for use with wagons having flaring sides, and used for hauling grain or granular matter, wherein the board provides an end gate capable of being entirely detached from the bed and wherein the pressure upon the board or gate may be first relieved before the gate is open and in position to be used as a scoop board.

COMBINED VARIABLE SPEED CLUTCH AND FREE WHEEL DEVICE FOR MOTORCYCLES.—A. H TRASER, Kensington Gardens, South Australia, Australia. The invention comprises a variable or expanding V pulley secured on the engine shaft but having a loose ring at the bottom of the groove, such pulley being connected by a belt to a rigid or non-expanding V pulley secured to the rear or driving wheel, the axle of the rear wheel being carried in plates movable toward or from the variable pulley the expanding V pulley being operated by a control lever with a connection also to the plates carrying the axle of the rear wheel.

GREASE GUN.—A. WHITE and M. GRANUM Montevideo, Minn. This invention has for its purpose the provision of a grease gun which is adapted to lubricate vehicle axles without the necessity of removing the wheels from the axles. The barrel of the gun is applied to the axle by placing it over the axle head, where it is threadedly engaged.

Designs

DESIGN FOR A COMBINED WATCH AND KEY RING STRAP.—D R. MCCULLOUGH 2212 E. 20th St., Oakland, Calif

DESIGN FOR MOTORMETER.—P F BEAULIEU, Bend, Oregon.

DESIGN FOR A LIGHTING FIXTURE ARM.—A MILLER, 2091 Prospect Ave., Bronx, New York

DESIGN FOR A NARROW FABRIC.—D. C. FRANK, c/o Pelgram & Meyer, 4th Ave. and 28th St., New York, N Y

DESIGN FOR A TOY.—R. L. HERMAN, c/o Mrs. Margaret S. Bartlett, 56 S. Walnut St., East Orange, N J

VISION

Steam from a kettle and the vision of that famous Scottish Inventor, Sir James Watt gave to the world the steam engine

The vision of Benjamin Franklin who with his historical kite demonstrated that lightening is an electrical phenomenon acquainted the world with its most powerful servant—Electricity

The vision of George Westinghouse in forcing the development of alternating current led to the great expansion and universal use of Electric Power in all Industry

In Railroad operation Electric Power has been demonstrating its suitability in the many classes of service

The future of Railroad Electrification will demand the concentration of large amounts of power at each moving train

The expansion of traffic will be effected by hauling heavier trains at higher speed over existing trackage

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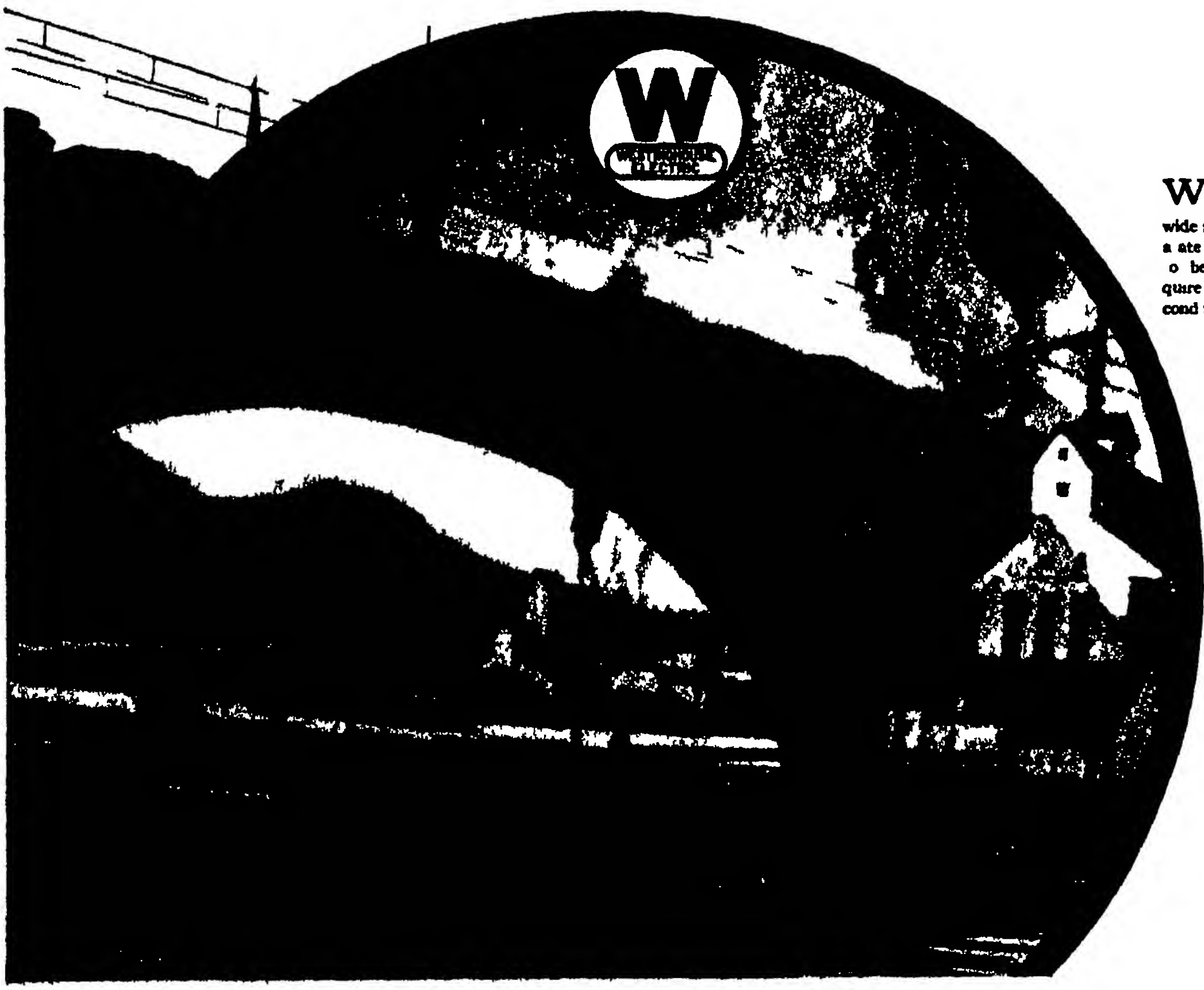

WESTINGHOUSE Railway Electrifications are world wide in distribution and each separate installation is designed to best meet the particular requirements that the operating conditions demand.

Westinghouse

ELECTRIC LOCOMOTIVES, LINE AND POWER PLANT EQUIPMENT

Book Reviews

A Survey of Recent Technical Works Published Both Here and Abroad

CHEMICAL ENGINEERING CATALOG. 1921. New York. The Chemical Catalog Company, Inc. 4to.; 1294 pp., illustrated Leased to chemists and the trade at $2; also on general sale

This Catalog is not merely a splendid directory, it has become an institution delivering unrivaled service to the chemical industries, with the authority of the three great chemical societies of the country behind it Its new format attractively combines durability and dignity, the thinner paper lightens the volume by several pounds, and the contents present the gist of a library of individual illustrated catalogs, conveniently assembled and indexed, supplemented by a classified directory of equipment and supplies, and an extensive bibliography The whole constitutes a dependable work of reference with precise data, specifications and tables Engineers, managers, buyers and purchasers will find the work so helpful as to produce the conviction of indispensability

P W-R MANUAL. Philadelphia Powers Weightman Rosengarten Co., 1920 8vo, 471 pp

This reference work may be used to great advantage by any who deal with industrial and pharmaceutical chemicals and their derivatives The bulk of the space is occupied by concise descriptions of the various substances —ingredients and proportions, physical characteristics, solubility, and reactions Other pages tabulate the international atomic weights for 1920, give and compare the metric and U S systems of weights and measures, deal likewise with thermometric equivalents, and include the specific gravity tables and equivalents of volumetric solutions. It is a decidedly valuable compilation

HOW TO KEEP INVENTION RECORDS By Harry A Toulmin, Jr, J D, Litt D New York and London D Appleton and Company, 1920 8vo, 85 pp, forms

While the first part of this book merely summarizes the principles on which patents, trademarks and copyright receive government protection the main section presents with a view to preventing litigation or lightening its expense a series of record forms that properly used, would frequently prove priority of invention or use. These forms include summary card, preliminary sketch sheet research record, material purchase record, etc In their direct bearing on the development, testing and control of inventions they are of considerable interest to manufacturers and large plants.

LESSONS IN ELECTRICITY AND MAGNETISM By William S Franklin and Barry MacNutt Bethlehem, Penn Franklin and Charles, 1919. 8vo, 254 pp, illustrated

A good elementary course for colleges and technical schools is provided in this text The authors believe in the use of the more powerful mathematical methods from the start, and as the two-year schedule in physics deprives teachers of the college-course mathematical basis, their method fills a need It reduces descriptive and explanatory material to a minimum, but so develops its topics as to lead directly into illustrative numerical problems Chapters on electron theory and electrostatics are particularly good

HOW TO MANAGE THE DYNAMO. By A. E. B. Bottone. Revised by C. Sylvester, A M I E E. New York Isaac Pitman and Sons. 16mo., 77 pp.; illustrated.

A simple book of instruction to dynamo attendants who are not expert electricians, it gives a clear understanding of shunt, series, and compound wound dynamos, of the component parts and behavior of modern machines, of testing with the milli-voltmeter, and of exciter operation and control

MOTORCYCLES AND SIDE CARS. By Victor W. Pagé, M.S.A.E. New York: The Norman W. Henley Publishing Co., 1920. 8vo.; 693 pp.; 375 illustrations.

As every motorcyclist knows, there is a dearth of really good handbooks dealing with the power-propelled cycle; but the dearth is of no consequence to the man who has this much-improved treatise at hand, which adequately describes all leading types, American and foreign, with the principles of operation. The parts most subject to wear are enumerated, and complete instructions cover starting and driving. The engine receives minute attention, a new chapter having been added on its thorough overhauling and repair. The new automatic lighting systems are made intelligible; and the abundant illustrations, many of them prepared by leading manufacturers especially for the work, constitute a valuable feature of the handbook.

THE MICROSCOPE. An Introduction to Microscopic Methods and to Histology. By Simon Henry Gage. Ithaca, N. Y., The Comstock Publishing Company, 1920. 8vo, 474 pp, 250 text figures.

Time and again Professor Gage has re-written his standard work, and we find this thirteenth edition again embodying the latest means and results, illustrated by abundant drawings It makes a feature of dark-field microscopy, with the new apparatus; shows details of a new and successful lamp, gives a method of producing line drawings from photographs, and has an enlightening section on the unit of measure for microscopic objects and for light waves. Progress in the general field is set forth in a symposium held last year by British societies

TYPES OF MENTAL DEFECTIVES By Martin W Barr, M D, and E. F. Maloney, A B Philadelphia P Blakiston's Son and Co., 1920 8vo, 179 pp, 188 illustrations

Those whose work lies among the feeble-minded need to know how to class these subjects properly, that the needs of the case and the possibilities of amelioration and progress may be early ascertained. This book facilitates diagnosis of mental, moral and physical defects, and presents the stigmata of degeneracy and the usual tests. Its classification begins with the separation of hopeless idiots and trainable imbeciles, there is a rather full study of cases, with numerous photographs, making the work distinctly helpful toward practical results

PRIESTLEY IN AMERICA. 1794-1804. By Edgar F Smith Philadelphia P Blakiston's Son and Co., 1920. 12mo, 173 pp

Finding the name of the discoverer of oxygen of frequent occurrence in the annals of American chemistry, the author of this little book instituted a research into Priestley's activities during his exile in this country Here we see him industriously mixing theology and politics with his experiments, and discovering carbon monoxide. It is unfortunate that his obsession by the phlogiston theory cheated him of further laurels and of truer interpretations The book outlines his life here from all angles, and is wonderfully interesting.

HANDBOOK OF BUILDING CONSTRUCTION Two volumes Edited by George A. Hool, S B, and Nathan C Johnson, M M E New York McGraw-Hill Book Company, 1920 8vo, 1474 pp., illustrated

Architects, designing and constructing engineers, and contractors will recognize in this work a successful effort to supply them with a vast amount of data in concise and convenient form An imposing array of specialists have had a hand in the work, so that the reader may place implicit trust in the various departments of information. Part I has the principal elements of structural theory, types of modern buildings, designing and detailing of structural members, general data, methods and equipment, and materials; Part II covers estimating and contracting; and Part III mechanical and electrical equipment. Commendation is due Mr. C. E. Ives for his drawings from which the nine etchings were made.

AUTOMOTIVE IGNITION SYSTEMS By Earl L. Consoliver, M.E., and Grover I. Mitchell, B.S. New York: McGraw-Hill Book Company, 1920. 8vo.; 269 pp., illustrated.

This new work offers a systematic course of study to all interested in automobiles and airplanes, whether they be owners or repairmen. Beginning with a sketch of electrical and magnetic principles, the work deals in an explanatory way with batteries, the [illegible] [illegible] [illegible], the [illegible] dynamos, [illegible] magnetos of both [illegible] and [illegible] types, the care and repair of ignition apparatus, and ignition troubles and remedies.

Miscellaneous Notes

Vegetable Flours.—Flour has been successfully made from both black and white beans, and a Brazilian installation is now turning out these vegetable flours."

Weekly Road Maps.—The Wisconsin Highway Department has been publishing every week a blueprint map showing routes and road conditions. The subscribers are chambers of commerce, hotels and garages. New construction detours etc. are plainly indicated.

How Athens Cleans House.—The dunce-cap method of correction is being employed by the Athens police in a clean restaurant campaign Finding restaurateurs unamenable to polite persuasion they now give the owner three days notice; if inspection at the end of that time shows no marked improvement, a large placard is placed over the door with the legend This Restaurant Is Not Clean

A Toy for England's Queen.—The Queen of England is to have a doll's house. Sir Edwin Luytens the distinguished architect will supervise the construction and famous artists and decorators including Sargent will ornament and beautify the interior The house will be eight feet high and representative of modern domestic civilization and art Miniatures of the royal family will adorn the walls and tiny statues will lighten the rooms.

"Has It Been Worth the Trouble?—An anonymous letter received by Webster condemning his Poker Portraits as disgraceful moves the cartoonist to review the march of humanity In pictures he traces the evolution of animal life from the Paleozoic age to the Neanderthal and Cro-Magnon man and thence to the blue-law fanatic The fact that it has taken 360 000 000 years of evolution to produce this sublime result has shaken his faith in the progress of humanity

Lifebelts for Violins.—When the *Ostend* mail boat carrying Jan Kubelik ran down a freight steamer in a fog the violinist lost no time in seizing a life-belt No fear for his own safety influenced him for the belt was carefully buckled not about himself but around the case containing his beloved Stradivarius which he values at $125 000 While the freighter went down with the loss of two lives there was fortunately no need for consigning the violin to the mercies of the Channel.

Night Terror in Children according to Dr Hamburger can be cured only by suggestion since it is invariably some psychic trauma that influences the dreams the child is still asleep or at least dream-dizzy even though he sees and can answer questions Dr Hamburger administers a placebo assuring the child that it will bring a night of unbroken sleep It should be noted that the shrieking of a child on the verge of a febrile disease is often mistaken for genuine pavor nocturnus

The Cruise of the *Ship-Shop*.—The decks of the *Raoul Briquet* have been turned into little streets of shops with famous firm names over the windows In this miniature Paris may be bought most of the wines lingerie medicines and toilet articles for which the *real* Paris is famous The ship-shop is now visiting the Baltic seaports and is everywhere enthusiastically received A press campaign precedes her arrival and the idea is *full of commercial possibilities* More ship-shops are planned to tour the ports of the world.

Paris to Be Finger-Printed.—Following the armistice 3000 criminals were loosed on society and Paris has known a reign *of* terror In an attempt to remedy conditions the Prefect of Police is requiring every one even casual travelers to show identification cards bearing their finger-prints these cards are provided *free* and there is a heavy penalty for failing to obtain one they will by providing prompt identification facilitate all official and banking transactions. Movies and newspapers have been blamed for the crime-wave but Lebon says *juries* provide the most fertile field for contagion The microbe of crime he adds, only attacks organizations already prepared *for it*

Flirtatious Islands.—French grammar is right, for once when it designates islands as feminine many of them appear and disappear like a face behind a fan and have to be wooed fervently before they are won Charcot's recent landing on the lost island of Rockall east of the Hebrides, recalls other elusive islands. Jan Mayen modestly veils herself in mist, and is seen but once in 50 years, while an islet in the Behring Straits surrounds herself with water so hot that fishermen say approach is impossible. Derwentwater has a bathing nymph of an island that floats for six weeks then coyly submerges Lange, the explorer made his home on a similar one at the mouth of the Amazon until the island eloped in an attempt to get rid of her guest.

Rain Insurance Popular.—Outdoor business undertakings and sporting events are peculiarly dependent upon dry weather for their profits, and a few hours of rain may cut them to zero. S K. Pearson Jr of the Weather Bureau notes the growing practice of guarding against loss by taking out rain insurance policies. Several companies have established "Pluvius Departments," and these make the Weather Bureau's data final and binding in the settlement of claims. The premiums are high or low according to local precipitation statistics. New York City has rain, on the average, every three days, with a normal annual fall of 44.63 inches. Last summer with its lengthy dry periods and all its holidays free from rain, found the insurance companies on the winning side of the wager

SOME TOOLS USEFUL IN CONNECTION WITH BELTING AND SHAFTING

Starrett Steel Measuring Tape

In steel or leather cases flush handle with push button release on opposite side Graduated in English or Metric systems as desired Finished in black background with bright steel figures and graduations with the foot figures before each inch mark insuring quick and accurate reading Bright background and black figures if desired. Lengths from 25 to 100 feet.

Starrett Improved Mercury Plumb Bob

Made from solid steel bored and filled with mercury Nickel plated and knurled Points hardened and ground. Patented slotted neck for fastening string without knots allowing bob to hang perfectly true

Starrett Improved Level

In addition to regular parallel vial the base has a cross level insuring the accuracy of the level when in a canted position The concave groove running the length of the base with flat margin on either side improves the seat for flat work and gives an absolutely true seat for shafting etc

Starrett Leveling Instrument

Light in weight and of simple construction Tripod of iron with telescoping extension legs adjustable to any length Light tube fitted with eye aperture and cross wires. Head is held to tripod with bolt and nut so as to make it stationary at any given point.

Starrett Key Seat Rule

Consists of machinists scale and an auxiliary straightedge held together to form a box square The auxiliary straightedge is either plain or graduated in 32ds or 64ths, as desired Is also made with graduations in the Metric system

Starrett Key Seat Clamps

Of case hardened steel and ground accurate will transform any common scale into a Key Seat Rule May be used with Starrett Combination Square Blades or any straight rule.

Starrett Center Tester

The indicating needle is adjustable to any length The ball which holds the needle as a chuck forms a universal joint but may be converted to a single joint for tilting motion by tightening the knurled nut adapting it for inside or outside surface contact The instrument is joined to a tool post shank by a flexible steel ribbon

Patents and Trade-Marks

General Principles, Current Comment, and Interesting Decisions

German War Patents in France.—Notwithstanding the fact that by the Treaty of Versailles Krupps may manufacture only the devices of peace this establishment has since the armistice taken out eight patents in France for guns gun equipment and a periscope for war submarines.

Fountain Pens Centuries Old.—Travelers were using fountain pens in 1600 and reference to them is found in an advertisement of 1763. About that time they assumed their present name, but did not come into anything approaching general use until fifty years ago. British patents were granted for fountain pens in 1809 one being to Joseph Bramah the inventor who gave his name to the Bramah lock and the hydraulic press

Recording Articles of Incorporation.—Articles of incorporation are now being recorded by the Patent Office at the request of attorneys, in order that the corporate names may be available for trademark searches. This course is due to an order of the present commissioner Mr Robertson, although the Patent Office does not advocate the procedure As long as the practice continues a charge will be made for such recording of $1 00 for 300 words or less $2 00 for more than 300 words and less than 1000 words and $1 00 for each additional 1000 words

Trademark Section of Official Gazette.—In response to the public demand a section of the Official Gazette containing all matters relating to trademarks may be procured separately beginning with volume 290 September 6 1921 The trademark section will include Trademarks published under the act of 1905 trademarks registered under the act of 1905 and under the act of 1920 labels and prints the indexes and decisions from time to time in trademark cases. The cost will be five cents for each number or $2 50 for annual subscriptions, to which must be added $2.00 to cover postage to subscribers in foreign countries.

First Use of Trade Mark.—The question often arises as to whether or not a trade mark registration can be obtained prior to the sale of the article with which it is sought to be used, so as to prevent another manufacturer from appropriating the trade mark Trade mark rights can only be obtained through adoption and use of the mark in question and the one who first so uses the mark becomes the owner irrespective of any question of registration It is absolutely necessary that the trade mark be used in association with the merchandise which it identifies, in interstate or foreign commerce prior to the filing of an application for federal trade mark registration.

Inter-Departmental Conference.—On July 25th last at Washington D C an Inter-Departmental conference was held for the purpose of formulating some plan looking to a coordination of the views now held in the various bureaus and departments of the Government in regard to patents arising within the Government service The meeting was of considerable interest in view of the many inventions created and patents obtained by members of the Government service while in such service, the purpose being not only to protect and safeguard the interests of the individual but the rights of the Government as well No definite plan has been as yet formulated, the discussion being merely preliminary but it is hoped that considerable progress will be made

Can a Patent Be Attached?—A patent is personal property a chattel and as such may be transferred to another The transfer is effected by means of a deed of assignment which sets over the entire or part interest in the invention and the patent covering it. However a patent cannot be attached as can other property by a judgment creditor A court of equity may however direct the sale of an inventor's interest in his patent to satisfy a judgment against him and it will require the patentee to assign, as provided in the Revised Statutes, Section 4898 and if he refuses, the court will appoint a trustee to make such an assignment. A patent right cannot be seized and sold on execution. On the death of the inventor or the assignee of the patent, the title therein passes to his administrator or executor

Utzman Patents for Gypsum Plaster Board.—The two Utzman patents Nos. 1 [illegible] and 1,[illegible]-746 covering respectively a process for making plaster board and the plaster board product, have recently been held valid and infringed by the United States Circuit Court of Appeals, Seventh circuit, in United States Gypsum Co. vs. Denzell Mfg Co, 270 Fed. 842. The decision is an interesting reiteration of the doctrine that utility increased output, improved product and reduction in cost are all factors of importance in determining utility and invention. The Court held that the extensive use that immediately followed the appearance of the new board was sufficient to show its utility and that in view of the factors mentioned the contribution of the patent spelled invention

Trademark Registration of Farm Names.—Some newspaper comment has been [illegible] that the Patent Office recently approved and published in the Patent Office Gazette a [illegible] covering the name of a farm of [illegible] to whom the registration was [illegible] breeder of purebred hogs. The [illegible] mark name is "[illegible]" However [illegible] ure is not entirely novel, and trademarks have frequently been registered in the past for farm products, shrubs, plants and the like. There is no reason why that should not be the case as such products may certainly be "goods, wares and merchandise" in the sense of the trademark law as may any other commodities. It would in fact be an excellent idea if more producers of natural products such as fruits, vegetables and the like would register their trademarks or trade names for the same. It has been done in a large measure by numerous fruit growers associations, canners associations and similar bodies.

Equitable Maxim in Case of Unfair Competition.—It is a maxim of equity that he who would demand equity of the court must come into court with clean hands. The Supreme Court of the State of New York, in a recent decision (*P. L. Le Bon, Inc vs Velmo*) has based its findings on this maxim in a case of unfair competition The plaintiff sued to restrain the defendant from selling a hair dye in a package almost identical in appearance and name with that of the plaintiff It appeared that the plaintiff's ware was produced in this country but that the dress of the package clearly gave the impression that it was the production of the French company originally manufacturing it, and so the court held that, "Under such circumstances the court of equity has uniformly refused to protect the use of a misleading trade name against imitation not because the defendant's misconduct is palliated by the plaintiff's conduct, but because the plaintiff has forfeited its right to relief because of its offense against the public.

Trademarks Applied to Imported Goods.—An interesting decision of the United States Circuit Court of Appeals, Second circuit, is that in the case of Bourjois & Company Inc. vs. Katzel. The Court held that "Where B. has bought from a French manufacturer the business and good will in the United States and sells goods manufactured by the French manufacturer which goods bear the trademarks used by said manufacturer and where K imports and sells the same goods bearing the same trademarks, held that K does not infringe by such sale. Trademarks are intended to show without any time limit the origin of the goods they mark so that the owner and the public may be protected against the sale of one man's goods as the goods of another man If the goods sold are the genuine goods covered by the trademark the rights of the owner of the trademark are not infringed by such sale It is not doubted that an American citizen may buy the business of a foreigner in the United States, with accompanying trademarks and having done so may subsequently change the character and quality of the goods at pleasure.

Proceedings of the Patent Section—American Bar Association.—At the forty-fourth annual meeting of the American Bar Association the principal subject coming before the Patent section was the preliminary draft of a new Federal trademark law This was prepared by a committee of which Edward S. Rogers, Esq. of Chicago, is the chairman The proposed bill contemplates a complete revision of the Federal trademark statutes, a revision such as had been advocated by many of the leading trademark practitioners of the country The bill was referred to a committee of eminent lawyers largely specialists in this field, and the committee was requested to make a complete study of the proposed bill and to report the same to the Patent section at its meeting in 1922 Copies of the bill may be obtained from the chairman, and the committee has announced that it will welcome criticisms and suggestions from members of the Bar Association. The Patent section also passed a resolution endorsing H R No. 7077 increasing the salaries of the employees of the Patent office, the funds for the increase to be derived from increasing the filing fee for patent applications from $15 00 to $20.00 This resolution of the Patent section was subsequently adopted by the Bar Association.

Employment of Another to Assist in the Reduction to Practice of an Invention.—When an inventor hires a mechanic or engineer to assist him in reducing an invention to practice, the question frequently arises as to what extent the employee actually participates in the creation or development of the invention, for obviously as the work proceeds the employee skilled in his field may readily depict changes or improvements. The courts have repeatedly passed upon this question and: "It is a well-established principle of the patent law that where an inventor employs another to embody his conception in [illegible] form he is entitled to any improvement [illegible] to the mechanical skill of the employe [illegible] [illegible]

[illegible]

& Clisby v [illegible] 166 C. [illegible]

Electrical Notes

Summaries and Excerpts from Current Periodicals

Electricity Kills Two.—An unusual accident occurred when an electric charge passed through a car of the New Haven railroad near Noroton, Conn. The car was one of a circus train and was occupied by colored minstrels. Following a sudden flash and roar two were killed and many injured. Officials of the road lay the cause to a 2-inch water pipe projecting 11 inches above the roof of the car which must have formed an arc with the overhead high-tension wires.

High Resistance in Small Packages.—A 50 000 ohm resistance unit in a space that could be covered with a business card is a specimen of the compact resistances being made by a New York concern. In fact, it is not the length of the resistance units nor their width nor their thickness that give the high resistance but it is the fundamentally new principle being applied to their construction. Furthermore these units are guaranteed absolutely non-inductive.

Additional Service from Dry Battery Carbons.—A method of reclaiming the carbons of dry cells instead of discarding them appears in a recent issue of *Engineering*. It is said that experiments tend to show that the cleaning of the electrodes and the removing of the deposits clogging the pores of the bag and of the depolarizer are more important than the actual reoxidation of the manganese. This is fortunate, for the reoxidation can not be effected by the simple chemical means.

Beauty with Utility.—The prevailing mode in highly ornamental ceiling lighting fixtures calls for a tassel—at least an imitation tassel of solid metal. It has remained for a Philadelphia manufacturer to find a use for the usual metal tassel aside from pure ornamentation and this he has done by making it in the form of a neat receptacle which can be used for attaching the plug of a table lamp. If a plug is not used a cap is fitted over the bottom of the tassel to cover the receptacle.

New Wireless Weather Service.—A new radio service is announced by the Weather Bureau co-operating with the Navy Department, for the benefit of aviators and mariners. It comprises first, a special bulletin containing surface weather observations from aerological station military and civil, with a summary of weather conditions forecasts and warnings and, second a localized service that broadcasts forecasts and warnings from naval stations. Full details may be had by application to the Chief of the U S Weather Bureau at Washington.

A Mysterious Stove.—At a recent electrical exposition a "mystic stove" attracted no little attention. This idea is by no means new in fact, in one of its most spectacular forms it consists of a kettle of water boiling on a cake of ice. The solution of such mysteries is powerful magnetic induction which causes the generation of powerful electric currents in the pot, pan or kettle. The layman is of course greatly mystified, since water can be boiled eggs fried and so on with no visible source of heat. The hand can be passed over the tapestry-covered table without feeling any trace of heat.

Toaster and Electric Heater Combined.—A New Yorker has developed an unusual form of electrical heating apparatus that may be used either as a heater or as a toaster. This device is made entirely of copper or brass and as a heater sits upright on fiber legs. In front is a removable wire guard while an elliptically curved copper reflector serves as the back. The coil type heating element inside is mounted upon a porcelain spindle equipped with a lamp socket base so that it can be readily taken out. Through the design of the reflecting surface the heat rays, so it is claimed are distributed over an angle of 100 degrees.

Mt. Tamalpais Searchlight.—News comes from San Francisco to the effect that Mt. Tamalpais is to have a powerful searchlight. This mountain is directly across the Golden Gate from the city and is about 2500 feet high. A 60-inch high-intensity searchlight is to be installed on the summit, commanding an obstructed view of the surrounding country and the sea. It is claimed by the builder of this searchlight that its beam is approximately 500 times more powerful than that of the largest locomotive headlight. When the atmosphere is clear the searchlight will pick up a battleship 18 miles distant, and the shaft of light will be visible at a distance of over 100 miles.

Electrifying the World.—Far lands are buying our electrical goods as never before. We flood the most obscure corners with light; our telephones vibrate to every tongue; the click of our telegraphs encircles the globe. Exports of electrical machinery and appliances went from $10 000,000 in 1915 to $24 000 000 in 1918 leaping to $113,[illegible] in the fiscal year 1921. The 17 000 000 electric lamps went to 75 different countries, the [illegible] worth of telephones to 60 and the $2,000 [illegible] went to 70 different countries; $2,000 000 worth of heating and cooking devices were also [illegible]. All this makes of prime [illegible] the establishment of a new "Division of Electrical Machinery" in the Department of Commerce.

[illegible] of Electric Railroads.—The first [illegible] in the world was installed by the pioneer Siemens at the Berlin exhibition in 1879 according to the American Electric Railway Association. The current was taken through a dynamo and conveyed through the rail. In 1885 a line was constructed by Leo Draft in Baltimore and this seemed to have been fairly successful. The first successful overhead trolley line was installed in Richmond, Va by Frank J Sprague in 1887. A score of short lines were built throughout the United States during the period of 1885-87. Most of them ran but a short time. The real start of the electric railway came after Sprague had completed his Richmond line.

British Radio Nomenclature.—Anyone who has had occasion to engage in a conversation with an Englishman or has read English literature has soon discovered that the English of Great Britain and the English of the United States have numerous differences. British radio nomenclature in this connection is of interest. The English radio man calls his vacuum tubes, radio valves. His tuning coil is an inductance coil. Binding posts are terminals. Amplifier transformers are intervalve transformers. Vacuum tube sockets are valve holders. Telegraph keys are tapper keys. Contacts for switches are contact studs. Hard rubber is ebonite. Condenser plates are condenser vanes. The radio amateur is the amateur wireless enthusiast.

Pantagraphs and Trolleys.—Writing in a recent issue of *Revue Generale de l Electricite*, M P Le Boucher gives first a theoretical study of the most desirable requisites of a pantagraph current collector such as (1) steady pressure irrespective of height of wire (2) great lateral steadiness (3) small air resistance and (4) small inertia so as to follow easily any change in height of the overhead wire. About sixty different pantagraph arrangements have been tested by this author and the results are given in tabulations and curves. While it is American practice to maintain an average pressure of 11 kg per square centimeter of the pantagraph against the wire French railways use only 4 kg to 8 kg per square centimeter.

Direct-Current Railroad Electrification.—Despite all that has been said regarding the advantages of alternating-current transmission there are more and more proofs daily that direct-current transmission over moderate distances has by no means gone out of style. The commission appointed in January 1920 to study the desirability of electrification of all railways in Holland has prepared a report which it is understood not only favors such a scheme, but recommends the use of 1500 volts direct current. It is also recommended that the electrification be made in connection with the proposed unification of electric light and power service throughout the country. There is no indication however that this work will be undertaken in the near future according to Consul-General George E Anderson.

Novel Storage Battery for Radio Work.—The requirements of radio reception work are such that the usual storage battery is not altogether satisfactory for the operation of vacuum-tube filaments. To the end of evolving a storage battery especially intended for radio work an American has recently introduced a battery of radically new design. This battery is claimed to be noiseless and to eliminate troubles often attributed to static but which are really due to defective B batteries. It consists of twelve cells of the lead-acid type, giving 24 volts, in one unit. The capacity is 10 milliamperes for eight hours or 50 milliamperes for one hour. It will furnish 300 milliamperes for a short time which makes its use possible for C W and radio telephone transmission. The elements of this battery are assembled in a vertical pile and appear very much like a pile of plates. The assembled battery is shipped ready for use except for a small quantity of electrolyte that must be added to each cell either with a medicine dropper or by dipping the whole battery unit into a vessel of electrolyte.

Welding and Cutting Arcs.—Speaking of electric welding operations before the American Electrotechnical Society an American authority stated that immediately after drawing a short arc the plate metal first liquefied appears to be blown from the crater terminal. Under proper conditions it is therefore possible to convert the welding arc into a cutting arc. While the source of this blowing action has not been definitely established the following effects appear to be contributory: 1 Impact of ions, cathode vapor gases, and globules. 2. Atmospheric convection currents. 3 Sudden liberation of gases confined in anode material. 4 Pressure on anode surface of gases formed by combustion of incandescent metal constituents with atmospheric gases. In the past, investigators of arc phenomena have confined their attention chiefly to the behavior of low-current arcs. The problems, however confronting the welding searchlight fuse, and circuit-breaker engineer can only be solved with a proper knowledge of high-current arc phenomena. While certain fundamental characteristics are common to both types of arc, it is evident that the complexity of the phenomena may increase with increase in current, rendering more difficult their proper interpretation and retarding their most effective utilization.

Aeronautical Notes

Recent Activities and Forthcoming Plans That Mark the Progress of Mechanical Flight

Amphibian Passenger Service.—Conveying passengers between central London and central Paris, alighting on the Thames and the Seine amphibious planes are to cut time and expense by making trips by auto to outlying airdromes unnecessary The machines are so built that in emergency they can safely come down on land This service will soon be put to a thorough test.

An Unusual Italian Monoplane.—An airplane capable of landing without the need of a large aviation field able to rise without a long run beforehand, able to travel more than 300 miles an hour and if necessary to drift along at a few miles per hour is announced to be the invention of an Italian engineer E Bertucci of Rome. The inventor claims to have tried out the machine on a small scale, and regards his experiments as proof of the success of his invention

French Activities.—The French military air service will have more than 40 000 airplanes next year if the Army budget passes into law without serious alterations. The French Flying Corps would then have 286 regiments each of 12 squadrons. French airplane constructors are in a very strong position mainly because the French Government, to help the industry allowed the constructors to execute most of the outstanding war contracts French constructors have on hand substantial orders from Japan and South America.

A Good Start for a New Machine.—Much interest attaches to the new British biplane the Mars I which was the winner of the Derby held at Hendon during thee middle of last July This machine is the creation of Mr H P Holland and was built by the Gloucester Aviation Company It is equipped with a 450-horsepower Napier Lion engine. The rear part of the fuselage of the Mars I is very much like that of any other fast scout machine but the forward part is distinctly different and accounts in large measure for the remarkable performance The front portion of the fuselage is quite high so as to take care of the engine and the water-cooling system as well as the gasoline tank

A Two-Cycle Engine of new design especially intended for aeronautical work is being constructed in Cleveland. The engine, so the report has it is of the radial type with six cylinder units, each unit being made up of two cylinders the pump cylinder and the firing cylinder The former draws the fuel from the carburetor and forces it at a high velocity through a by-pass port into the latter just as the exhaust port begins to open The damp charge falls on the burnt one like a blanket scavenging the fired cylinder completely The crank shaft and connecting rods operate similarly to those of the conventional four-cylinder radial engine The fuel consumption of this engine is expected to be exceptionally low

A 4000-Pound Aircraft Bomb.—The Ordnance Department of the Army is making plans for an aerial bomb to weigh 4000 pounds which is very much larger than any bomb of the kind ever before conceived in the United States. It is to contain over 50 per cent or 2400 pounds of TNT and will be one of the most deadly of all bombs known in modern warfare. Up to the present the largest bombs designed and constructed weigh but 2000 pounds. These already have been adopted as standard, together with bombs weighing 1100 pounds 600 pounds, 300 pounds and 100 pounds respectively all of which contain about 50 per cent of TNT The new bombs weighing 4000 pounds are to be used in connection with the largest bombing airplanes.

Aircraft Insurance Rules.—It is interesting to note how insurance companies are now ready to accept the air craft and its passengers as a reasonable risk During 1921 several changes have been necessitated by reason of the heavy losses during 1920 While the executive committee of the National Aircraft Underwriters Association felt that the rates must be kept down as low as possible it has found it necessary to take certain precautions. It has been decided therefore that fire transportation, theft windstorms and collision coverages shall all embrace the 75 per cent loss payable feature whereby the company pays three-quarters of each loss (or three-quarters of the excess portion of each loss) for each coverage that bears a deductible feature The companies hope to bring about considerable improvement by the use of this clause There is no question but that an insured person will be a little more thoughtful and perhaps a little more careful if he knows that he is not to be fully reimbursed for each loss that may occur

The Bourke Turbine Propeller, according to *Aeronautics*, is a new type of airscrew construction which is built on lines that are quite contrary to the usually accepted theories of propeller design. In brief the turbine type is simply an ordinary airscrew which has vanes projecting on both sides. The actual size of the vanes, their position on the airscrew their intervals, the material from which they are made and the method of fixing them has been the subject of a great deal of thought and experiment on the part of Mr Bourke, the inventor and patentee and Mr J W Carr his technical engineer and consultant. It is claimed for the turbine principle that it is not only more efficient, but that it also causes a marked reduction of vibration and noise. Its use is by no means confined to aircraft, but applies also to water propellers, ventilating fans, and the like As regards the method of construction the vanes are made of steel and screwed on to the wood of the propeller Experiments were made with aluminum but it was found that this would not stand up to the work.

Bolshevik Aviation.—It appears that the Red Army of Russia has not lacked airplanes despite its numerous campaigns on many fronts. In fact, during the latter part of Russia's participation in the World War as one of the Allies, most Russian airplanes were of domestic manufacture and when the Bolsheviks came into power they naturally came into possession of the aircraft factories. The main problem of the Red Army as far as aviation is concerned has been to find faithful pilots. Numerous Bolshevist pilots surrendered to the Whites, despite the fact that they had Communists for observers, and many valuable military secrets were thus revealed to the volunteer army To overcome this difficulty the Bolsheviks began to train Lithuanians and Chinese. The results, however were poor for the new pupils crashed so many machines that the only producing aircraft factory Dux could not keep pace with the spare parts and new machines required Finally the Bolsheviks limited their activities to scattering propaganda from the air The naval end however is said to be far more active.

Flexible Fuel Pipes.—Though no doubt permanently fixed steel piping for gasoline and oil systems in aircraft is preferable to copper piping nevertheless rigid piping of any kind is liable to fracture by vibration or to damage by careless workmen, or by accident, when work is being done on other parts of the machine Obviously flexible piping is preferable to any kind of rigid piping if a satisfactory flexible pipe which is gasoline oil and water proof can be had Hitherto states *Aviation* the right kind of pipe has been lacking—at any rate since the Bowden flexible pipe was abandoned—or else where a satisfactory pipe has been found it has been impossible to discover a trustworthy joint for it. These difficulties seem to have been overcome by a British manufacturer in a pipe that is itself composed of an inner layer of gut—either pig ox or horse—strengthened by canvas and protected from external pressure by wire winding Animal gut is found to be proof against gasoline oil and water Canvas is the best strengthening material and wire is the best anti crush material.

New Italian Parachutes.—A recently introduced Italian parachute while it does not differ fundamentally from the general design of such equipment, incorporates some new ideas as to detail design, we learn from a contemporary This applies in particular to the opening device and the cover In this parachute the shroud lines are led around the periphery through a large number of aluminum rings sewed on to the edge of the cloth. This makes the opening of the parachute rapid and positive and it is said to be less liable to damage than the rubber tube used as a shroud lead on the French individual parachute, which is liable to tear The folding of the Italian parachute is also easier and in operation the opening takes place with a minimum of jerk. The collective, or nacelle parachute permits the salvage of the crew of a free balloon or a kite balloon together with the basket instead of the occupants, jumping singly overboard with parachutes. The nacelle parachute is fixed to the basket from the gas bag The release gear is controlled by the pilot. It appears from trials that a basket or car weighing less than 800 pounds equipped with such a parachute will descend at the rate of 12 feet per minute.

Mine-Laying Airplanes.—With the experimental work in the tactical use of aircraft such as the making of smoke clouds to hide formations and maneuvers the dropping of toxic gas bombs from aircraft, and the construction of airplane carrier ships, it may be expected that the Naval Air Service will conduct tests of harbor and inlet protection with mines laid from airplanes. It would be an enormous task, and an expensive one in time and material to cover any large area in this manner but where there exists the combination of a limited period of time for the work and a small area to be covered airplane mine-laying might reasonably be expected to be successful. Little has been done along this line, though the Germans did successfully attempt the method on the Baltic Sea in 1917, we are reminded by *Aviation*, using seaplanes of the float type known as torpedo planes. These were two-engined machines using either 260-horsepower Benz or 260-horsepower Mercedes engines. The use of twin floats permitted the attachment of the mine, or torpedo, between them and under the fuselage. A release system was arranged so that the mine could be freed by the pilot. These airplanes were normally loaded with eight 110-pound bombs or one torpedo. In laying mines, the airplane was flown within ten to fifteen feet of the water, and the mines, which weighed 900 pounds, with an explosive charge of 440 pounds, were released, automatically anchoring after sinking to a predetermined depth.

Mechanical Engineering Notes

Survey of Progress in the Mechanical Arts Gathered from Various Sources

Metal Spraying—The Schoop process of spraying metals has been making remarkable headway in many countries. It is now being employed for a wide variety of purposes ranging from the spraying of zinc on iron members for outdoor purposes to spraying zinc on the back of positive glass plates so as to obtain a wonderfully effective silver picture

Air-Operated Arbor Press.—An American builder of machine tools has recently introduced an air-operated arbor press designed for work usually performed with hand-operated presses. Arbors bushings and similar parts are pressed into desired position with one stroke The downward stroke of the ram is controlled by means of a stop collar thus enabling the operator to perform delicate operations automatically The piston is equipped with a composition cup packing supported with suitable expansion rings This construction provides a self-adjusting piston

Cloth That Cuts.—Remarkable properties are claimed for a special cloth recently introduced in machine shops. It is said that this new cloth takes hold, bites right into the work as it were leaving a finish that is clean It stands up to its work without cracking peeling or losing its grain As far as speed is concerned it is the fastest cutting cloth yet introduced so it is claimed It cuts fast because it is coated with selected hard, sharp grains of a most efficient abrasive It is uniform because it is coated with positively uniform clean accurately graded grain. It shows long life because it is durable and flexible.

Keyseating Long Length Holes is a difficult job under any circumstances while it is a simple operation with a recently introduced tool so it is claimed. It is as simple as drilling a hole The tool is fitted with a high-speed rotary cutter for milling internal keyseats in one cut. By passing the tool through the hole once only the keyseat is completed This tool may be attached to the usual drill press, so that the latter can be made to mill internal keyseats in places where planer shaper and keyseating machines can not reach The miller is regularly made in twenty different diameters and eccentric bushings can be supplied for each size whereby one miller may be used in keyseating holes larger than the tool's own diameter

Protecting the Surface—Since the atmosphere has such a deleterious effect upon many metals it becomes necessary to protect the metal from the air and this is more readily accomplished by simply painting with ordinary paint, enamel or with oil. Metal coatings are also supplied the most usual form being the familiar galvanized or tinned iron It is well to point out here that unless the tin coating completely covers the iron base it is preferable that there be no coating at all. Iron is electro-positive to tin and if any pinholes are present it can be readily understood that the corrosion of the iron will be accelerated rather than retarded Zinc on the other hand is electro-positive to iron and the effect of any incomplete covering of the iron base would be to corrode the zinc rather than the iron

Radical Changes in Lathe Design are claimed by a builder of special lathes for his products Among the distinct and rad cal improvements in the design of his new lathe he claims the follow ing 1 Constant speed motor drive armature shaft connected directly to the drive shaft eliminating belts tension idlers and chain drives with their consequent trouble and inefficiency 2 Headstock cast integral with base increasing strength and accuracy 3 Extra large spindle and spindle bearings. 4 Herringbone gear drive to spindle 5 Splash oiling system gears operate in oil bath. 6. Twelve speed changes and twenty-eight feed changes. 7 Gears always in mesh—speed and feed changes made without stopping lathe—no chance of stripping gears. 8. Wide ways with 15 deg angles, vertical and horizontal. 9 All controls on the apron at the operator's finger-tips. 10 Greater percentage of power delivered at the cutting tool than any other lathe

Speeding Up Gear Cutting—When a large number of gears are to be cut it has been found advantageous to make both roughing and finishing cuts at the same time by the double cutter method Both the roughing and finishing cutters are mounted on the cutter spindle The roughing cutter is mounted on the outside which permits its easy removal for resharpening without disturbing the adjustment of the finishing cutter When taking the first cut both cutters must cut through solid stock, requiring a slow feed. To avoid the loss of time and trouble which would arise from either feeding by hand or changing gears, a leading machine tool manufacturer has designed an automatic feed change mechanism that can be furnished as an extra for use on gear-cutting machines. This mechanism is engaged for the first cut which is taken at a slow feed. At the first reversal of the cutter the feed mechanism is automatically tripped engaging a feed twice as fast for the remaining cuts.

Why Chain Drive?—Certain conditions, of [illegible] the use of belt or gear drives impossible; for instance, take a furnace where [illegible] the belt is [illegible] or in very dusty [illegible] Either the belt or gear drive would be [illegible] the belt would perish in the former case and the gear would become clogged in the latter Satisfactory chain drives can be designed to operate efficiently under these conditions. Another advantage of the chain drive over the belt is in the distance between the driving and driven centers A belt will not operate where the center distance is too small owing to its lack of flexibility wh ch would mean that only very small portions of the pulley faces and the belt surface w uld be actually in contact Chains can of course be used between wheels that are very close together thus effecting a considerable saving in material and space which both mean money The high efficiency of a chain will not deteriorate even after years of hard service provided of course that the chain has been well made and correctly installed This fact continues *Cheap Steam* is partly due to the low friction in the drive and also to the fact that the driving strains are distributed among a large number of self contained units.

Tests on Hollow Steel Castings.—A paper issued by the Bureau of Standards at Washington gives an account of the tests on six hollow cylindrical steel castings manufactured by the centrifugal process The castings were 6 feet long and of diameters up to 18 inches with holes of various diameters through them and they were made with the mold revolving about the axis at a speed not specified. Samples of the metal taken from different parts of the complete castings were tested for hardness, tensile strength soundness, structure and density both in the condition as cast and after heat treatments of various kinds It was found that there was a slight segregation of carbon phosphorus sulfur nickel and copper in the radial direction but none of the manganese and silicon Small blowholes were evident in the inner 1/16 inch of the castings After heat treatment several of the castings showed mechanical strength equal to forged materials of the same composition and satisfied the ordnance requirements for gun forgings Microscopic examination showed no hard spots, flaws or other defects outside the layer 1/16 inch thick at the inner surface, and the process appears to be one of great promise.

A New Dieing Machine—With the development of a new dieing machine the days of the old top heavy vibrating punch press are numbered so we are i formed by mechan ical engineers The flywheel and crank shaft of this machine are located below the dies transmitting the power to a lower gate or crosshead guided on long ways located on the frame of the machine which takes the side as well as the vertical thrust. The lower gate is connected with the upper cross-head that carries the punch or punches, by four chrome nickel steel rods guided in long adjustable bronze bushings By this construction the upper crosshead is subjected to no strain except direct ver t cal pull applied at the corners instead of in the center giving perfect alignment to the punch and die exactly as in a sub-press Other advantages that are said to result from the driving mechanism being below the die plates are the following More correct strains greater strength better balance greater speed capacity no obstructions to light dies more accessible and better lighted longer life for dies because of imposs bility of getting out of alignment greater life of bearings interchangeability of bearings less oil attention greater production less vibration; less attention less labor cost.

Fine Castings in Sand Although it is not the process used by counterfeiters most green sand molders know that w th the exception of loss of size owing to contraction coins can be exactly duplicated by the proper preparation of the sand used for facing the molds and in the making of fine-skinned castings th s preparation is taken advantage of The casting is an exact replica of the space in the mold, assuming that the metal is clean and the mold properly made a rough-grained sand leaving a rough surface on the casting and vice versa but the thickness of the facing need not be great, a quarter-inch thickness or less according to the size of the casting being ample the body of sand in the mold not affecting the skin of the casting although if not porous enough it may affect the casting as a whole Polishing the mold with extremely finely powdered graphite or steatite, according to the metal cast adds to the fineness of the skin of the casting but this point has to be largely decided by the molder continues *The Practical Engineer* The sand for facing should always be dried before sieving as this largely insures the separation of the grains without removing the binding material but the rejections should always be crushed and again passed over the sieve to prevent loss of essential parts as far as possible. With iron coal dust is added, and with brass and bronze pea or bean meal is made an addition to the sand, which is again sieved after the added material has been thoroughly mixed in damping being done a few hours before using As a rule it will be found necessary to ram the surface of the mold fairly hard, and for this reason it is desirable that the sand should be worked as dry as possible consistent with good working, while very adequate venting is also found a necessity as a general thing care being taken that the vent wire does not actually touch the pattern.

Miscellaneous Notes

Travel on German Railroads increased this year over last but Germans are traveling third and fourth class it is cheaper by one third-class sleeping cars than to live in a hotel.

For Lack of a Railway.—From 60,000 to 100,000 tons of shea nuts are annually rotting along the Gold Coast of Africa; 300 miles of railway would provide a remunerative outlet for these nuts.

Water Power in Sweden.—In 1920 Swedish hydro-electric stations were developing 1 200 000 horsepower Equipment since added probably brings the total very close to 1 500 000 horsepower

Smoky London.—The thickness of the London atmosphere is more than half due to her coal-burning locomotives during the coal strike, oil burners appreciably relieved the situation but now that the roads have gone back to coal the city has redonned her yellow cloak.

A Seagoing Raft.—A Japanese firm will make an attempt to raft timber from British Columbia to Japan The raft will be of the Davis type with a superstructure of piled logs strongly lazed Twenty years ago a raft made the journey from San Francisco to China, favored by exceptional weather

Railroad Signal Experiments made at Waterloo Station London favor the 'three position light system The filaments are in the focus of a dioptric lens of white glass the rays emerging through greenish-yellow glass, can be seen for over a thousand yards in bright sunlight, and penetrate fog better than white light.

New Observation Cars.—On the Cascade Mountains route between Seattle and Cle Elum the Chicago Milwaukee and St Paul Railway Company has something new in observation cars. The seats are arranged as in a sleeping car the car is open at the sides above the seats, and there are glass windshields between each section with an uncovered space at each end of the car

Dust Spraying for Coal Mines.—From the *Canadian Mining Journal* we learn that in Westphalia a hand-spraying device consisting of a hopper-shaped bucket filled with stone dust and carried on the shoulders is used to spray mine roofs and sides otherwise inaccessible A trailing connection to a compressed-air pipe furnishes the power the bucket has a long spout to direct the spray and an injector sucks the dust from the bucket and delivers it with great force.

High Altitude African Railroad.—The British government has awarded contracts for the construction of a railroad from Nakuru to the Uasingishu plateau north of Victoria Nyanza, which will attain the greatest altitude of any railway of the British Empire its highest point will be more than 9000 feet above sea level The road will cost $10 000 000 and may later be extended into Uganda, connecting the port of Mombasa with the Cape-to-Cairo route.

Fleet of Oil Burners Planned.—The Canadian Chamber of Commerce announces a plan nearly completed to run oil-burning steamers on a four-day schedule between England and Canada There will be 8 vessels of 50 000 tons each, carrying 600 first-class and 3000 second-class passengers, and making 26 knots. The service is later to be extended to all parts of the Empire making it possible to go from Liverpool to Sydney via Halifax and across Canada by rail in 20 days it now takes 58 days.

The Toll of Industrial Accidents.—At the convention held in Chicago last September S. J Williams, secretary of the National Safety Council gave the annual loss due to industrial accidents as $1 000 000 000 The wage loss is about $858 000 000 the surgical, hospital and administrative expense adding $161 000 000 to the appalling bill. A New Jersey representative told of the progress made by the Department of Labor of that State in safety education and the enactment of better industrial laws.

Scientists in the Cordilleras.—A Swedish commission aided by the Peruvian government, is studying little-known regions of the South American Cordilleras. The glacial features of the Sierra section south of Oroya were investigated; the expedition then descended the Perene on rafts to its junction with the Ene; returning, fossils were found in the Pangoa valley Thence the party went to the San Rafael Lake district of Chili intending to ascend a glacier to study the inland ice The ethnology of the Indians also yielded interesting material

Farm Implements in 1920.—The United States manufactured farm implements to the value of $537 000 000; gas tractors accounted for a third of the total—203 000 of them, valued at $180,000 000 then there were 1 000 000 plows with a value of $46,000,000 255 000 wagons valued at nearly $32,000,000 and 412 000 haying machines worth nearly $35 000,000. These summaries were made by the Bureau of Public Roads from the detailed reports of 523 manufacturers, and at least 90 per cent of the entire industry is covered by the figures.

The Sirocco Fan.—This fan, invented by Sir Samuel C Davidson to dry tea, now finds its most important application in the ventilation of ships and for forcing draught in the [illegible] though subways and theaters also use it. The objection to the common propeller fan, having different points along the blades moving at different speeds, is in the sirocco fan obviated by using a ring of blades all moving at the same velocity. The moving part is [illegible] in air at the center and [illegible] at an stationary [illegible] any other fan.

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Notes and Queries

The Notes and Queries column is maintained for the benefit of our readers who desire information on subjects germane to the scope of the paper together with technical formulas and similar information. Matters requiring profound research or searches in a library cannot be undertaken. In connection with Notes and Queries proper we maintain a "Service Bureau," which is able in nearly all cases, to supply addresses of manufacturers whose articles have sufficient novelty and merit to be illustrated in the news pages of this periodical. Correspondents are requested to write their inquiries in all cases, making the subject of the letter entirely separate from the correspondence relating to patents, subscriptions, books, etc. This will greatly facilitate the answering of these questions which in many cases have to be referred to experts. The full name and address should always be given. Our full "Hints to Correspondents" will be gladly mailed on request. All letters are answered by mail and only a very few of them can be printed in the limited space at our disposal.

(14371) R. L. J. asks: Can ice go in temperature below 0° C? For instance could it be at 0° F? A. If a piece of ice is put into a place where the temperature is zero, it will soon come to that temperature and be also at zero. Ice is a solid and has the same properties as any other solid. It can be heated and cooled just like any other solid. Of course it cannot be heated above its melting point. Neither can any other solid. Iron melts when its melting point is reached. So too does a wax candle and everything else. Each solid has a melting point, and at that temperature it changes to a liquid. The only peculiarity of ice is that it melts at a low temperature. But mercury melts much lower at 40 below zero F and alcohol melts at 200 below zero. Yes, ice cools like any stone, and the other day when the mercury was down nearly to zero here a piece of ice stuck to the fingers just as a very cold piece of iron would do at the same temperature. There is no doubt that ice can be cooled below its freezing point. It is not a good conductor of heat and would not cool very rapidly but give it time and it can be cooled to any degree.

(14372) R. L. says: Some thirty years ago the so-called "Pharaoh's Serpents" were sold on the street in little boxes. A. This article has not been sold recently but is an interesting chemical novelty. These serpents are little cones of sulfocyanide of mercury which, when lighted give forth a long serpent-like yellowish brown body. Prepare nitrate of mercury by dissolving mercury dioxide in strong nitric acid as long as it is taken up. Prepare also sulfocyanide of ammonium by mixing 1 volume of sulfide of carbon 4 volumes of a strong solution of ammonia and 4 volumes of alcohol. This mixture is to be frequently shaken. In the course of about two hours the bisulfide will have been dissolved, forming a deep red solution. Boil this until the red color disappears and the solution becomes of a light yellow color. This is to be evaporated at about 90° F until it crystallizes. Add, little by little, the sulfocyanide to the mercury solution. The sulfocyanide of mercury will precipitate; the supernatant liquid may be poured off, and the mass made into cones of about one-half in. in height. The powder of the sulfocyanide is very irritating to the air passages and the vapor from the burning cones should be avoided as much as possible. To ignite them set them on a plate, or the like and light them at the apex of the cone. If you have had little experience in chemical manipulation it would be wise to substitute for this formula the following: The cones may be made of comparatively safe material by the following formula: Potassium bichromate, 2 parts; potassium nitrate 1 part; white sugar 2 parts. Powder each ingredient separately, mix, and press into small paper cones. These must be kept from light and moisture. Of course neither this nor other chemical toys containing substances in the slightest degree harmful if swallowed, should be placed in the hands of children not old enough to fully understand the danger of eating or even tasting unknown things.

(14373) H. G. asks: Is there only one day which is the shortest day of the year or are there two or more days which have exactly the same length at the shortest period of the year? If it is not too much trouble, could you tell me the dates of the above for the years 1920 and 1921 also the length of day? A. There is but one shortest day in the year, whether you mean the shortest time from sunrise to sunset or the time from midnight to midnight. The shortest time from sunrise to sunset was, in 1920, on December 21st and in 1921 it will be December 22nd. The shortest day time is on the day of the winter solstice, which occurs as we have given above. It is given each year in the Old Farmer's Almanac which is published in Boston and is commonly used in New England. It shifts in the calendar because of the extra day which is inserted once in four years in February. The day from midnight to midnight is shortest about July 1st, and longest, about January 1st.

(14374) A. J. C. says: How can I pul-[illegible]

[illegible] assorted to size of laminae. The finer filaments have a pearly luster and are made to adhere to semi-softened gelatine and wax to imitate pearl. The silvery powder is used on metals, glass, wood, paper, plaster, tapestry and furniture. It has also been used in calico printing in place of the heavy bronze and glass dust of Lyons fabrics and for the decoration of china and glassware.

(14375) E. V. W. asks: About 7 or 8 years ago in the original theatrical production of "Everywoman" a transparent mirror was used and I am curious to know the chemical solution that was used on the glass to produce the effect of a mirror and at the same time permit of the glass being transparent. A. We do not know what was used for making a transparent mirror in the play to which you refer. It is not necessary to coat the glass with anything to make it reflect a strongly lighted object such as a person clothed in white or a brightly lighted room. A plate of mirror glass set at an angle will reflect what is placed at one side and also allow one to see what is behind and beyond the glass. Ghosts are made to appear in this way.

(14376) C. H. M. asks: (a) Two men of equal weight are suspended on a rope ran over a single pulley. Is either of them able to move on the rope or does either of them have enough weight to pull against to be able to move? If A attempts to move what effect will it have on B? Does the foot-pounds of work done by A enter into the solution of the problem? (b) Would a cable suspended in the air ever break with its own weight? It would be possible to roll the cable into a roll and tie it to the end of the cable and break it but if suspended in air would not the entire cable be holding up part of the weight of the cable below it? A. (a) In the case which you propose if A gives a sudden jerk upon the rope he will give a motion to B. If he pulls steadily he will not move B. The sudden jerk will overcome the inertia of B and move him up a little. The weight of A balances the weight of B. This is easily settled by trial. Try it and demonstrate for yourself. We do not see that foot-pounds enter into the case at all. A does not do any foot-pounds of work unless he moves through some space. (b) Certainly a rope will break by its own weight just as easily as if it is lifting a weight. If it is laid across between two towers the pull of gravity upon it tends to stretch it and break it in the same way as if it were lifting a weight vertically. The pull upon the cable is all of it transmitted to the towers and tends to pull them over. If this pull is more than the rope can stand it will break. One part of the rope does not carry the weight of another part. The whole weight of the rope pulls against the top of the tower.

(14377) M. A. K. asks for formulas for polishing rags which can be made at home. A. (1) Saturate woolen stuff with a solution composed of 3 oz. 4 dr. of Castile soap dissolved in 14 oz. of water; to this solution add 22 dr. of tripoli. Color with coralline. (2) Serviettes magiques, for polishing articles of metal, consist of pure wool fabric saturated with soap and tripoli and dyed with a little coralline. They are produced by dissolving 1 part of Castile soap in 4 parts of water by weight, adding 2 parts of tripoli and saturating the fabric with it, allowing to dry. (3) In 20 oz. of water dissolve 4 oz. of soap and gradually add 2 oz. of pumice stone or finely powdered emery. (4) Infusorial earth may be used with advantage. Saturate the best unbleached muslin with this paste. Color with a little aniline red, if desired.

(14378) D. R. R. says: I am interested in the difference between natural and artificial ice. I have heard that natural ice will average about five degrees colder than artificial ice but cannot see how this can be. Also that artificial ice will not store as well as natural ice. A. The chief difference between natural and artificial ice lies in the fact that natural ice frees itself from air in the act of freezing. The water from which artificial ice is frozen is in iron cans and is immersed in the vats of cold brine to be frozen. It freezes over the top and shuts the air in. It also freezes on all the sides and drives the air toward the center of the block of ice. You have doubtless observed the great number of air bubbles toward the center of the block of ice. Artificial ice is undercooled to make it last longer in carrying. Natural ice takes the temperature of the air in which it is, as also does artificial ice after it is taken out, if the air is below freezing but if the air is warmer than that, the ice comes to its freezing point, 32 deg. F. and then melts. There is no basis for saying that natural ice will remain five degrees or any other number of degrees, colder than artificial ice.

Science Notes

A Digest of Everything of General Interest Appearing in Current Literature

Ampere's Centenary.—French electrical engineers are restoring the tomb of the celebrated physicist in the cemetery of Mouthwaite.

Traveling Hospital for Indians.—A motor truck elaborately equipped as a medical and dental clinic is visiting the remote Californian tribes, accompanied by a physician and a dentist.

Lightning Dismembers a Statue.—Lightning has torn off the arms of a statue at Château-Lambert France erected as a thank offering after the cholera epidemic of 1854 had passed.

Wealth Vanishing in Smoke.—Every year 32,000 forest fires, involving some 12,500,000 acres of timberland, cost us $20 000,000. Greater vigilance would save much of this appalling waste

Possible Oil Discovery in Australia.—Very rich oil shales exist in Australia and Tasmania, and wells are now being driven in the hope of striking oil Gas has been obtained but no oil—as yet.

Who Invented the Friction Match?—A German chemist has made an exhaustive study of this question and concludes that no one person can be considered to be the inventor of the friction match.

Fighting Famine with Swamp Roots.—Samara University hopes, through its discovery of the edible qualities of "awsan" a swamp root, to reduce the suffering in Russia by one-half Awsan contains 70 per cent of starch, considerable albumen, and some fats

Old Clothes for Radium.—To disguise his precious burden an officer of a Colorado radium company brought nearly $80 000 worth of radium to Philadelphia in an old battered fiber suitcase The precious substance was deposited in the vaults of a trust company on arrival.

"Papering" Melon Fields.—Out in Wenatchee Washington, they are covering the fields with roofing paper, cutting out round holes for the melon hills It is found that by this practice all weeds are smothered and there is a 50 per cent saving in labor for cultivation and irrigation

Edinburgh Meeting of the British Association.—The September meeting of the British Association held at Edinburgh was of great importance, as science has begun to right itself after the war The conference was divided into thirteen groups Over 1,200 visiting members of the Association were present. Prof Arrhenius was the star scientist.

First Appearance of the Mastodon.—It would seem from a recent report, that the true mastodons made their appearance in this country at a much earlier period than was heretofore presumed One found in Nevada places their existence as early as the Middle Miocene Previously the earliest finding was from the Middle Pliocene

Our Gifts of Tree Seeds to Europe.—Great Britain used up 1,500 000 acres of timber during the war In 1919 we made England a present of 25 million tree seeds for reforestation purposes the American Forestry Association is asking what disposal was made of these seeds France was given an equal number of seeds of evergreens, Oregon pines and Weymouth pines

Beavers Dig to Freedom.—The colony of beavers at the Zoological Park of New York have tunneled under the foundation wall and escaped to the upper reaches of the Bronx River One was ignominiously captured under a wash-boiler Many keepers camped on the trail of the others, but the 'call of the wild" proved to be too civilized and the beavers returned to their home in captivity and they seemed glad to be home.

Camouflage Unmasked.—The gun-concealing painted shrubbery of the Germans is rendered useless by taking advantage of the fact that real leaves reflect red and green light, the painted foliage green light only Viewed through a "light filter" the difference is apparent. The countermove was to use such pigments in camouflage as would produce the red-light reflection This was done, and the battle of the scientists goes merrily on.

Amundsen to Try Again.—Early next spring the schooner "Maud," now repairing and outfitting at Seattle, will again be driven northward in an attempt to prove Amundsen's theory that, by taking advantage of the right current, a vessel frozen in the ice will drift across the Polar Sea in less than five years Twice his efforts have been unsuccessful, and in the second venture a propeller was broken. This time the ship will carry two airplanes furnished with sleds.

Taking the Battle Out of the Rattlesnake.—In a combat between a diamond rattlesnake and a blue racer, the latter was victorious over his more virulent adversary. During the fight, reports a writer in *Science*, the racer was badly bitten by the rattler—whereupon the former worked his way to a patch of weeds and bit into the stems extracting the juice, after which he returned to renew the fray This peculiar performance was repeated in a short time, when the racer again returned and destroyed the rattlesnake.

Blinding the Motion Picture Actor.—An English committee traces injuries to the eyes of actors to the use of open arc lights; they discovered no permanent damage to sight, but reported that unscreened arcs are not only unnecessary but actually give less satisfactory results The Association of Kinematograph Manufacturers has promised the Ministry of Health to enforce the use of filters in their studios. There is much room for scientific research as to the best type of lamp.

How Flying-Fishes Fly.—Some highly interesting observations on flying-fishes have been made by Dr E. H. Hankin in the Arabian Sea. In still weather the length of a glide was about a meter, with considerable lateral instability in a light wind this was increased to from 200 to 400 meters. A resemblance between the wing action of soaring vultures and the fin action of the fishes was marked. In both, the wing or fin is inclined upward, the outer part at a higher level than the base, in slow-speed flight, while both show a downward inclination in flight at high speed.

Poroscopy and Graphometry.—As if the way of the transgressor was not hard enough already, Dr. Locard, a world-wide authority on criminal identification, has elaborated two new plans which seem to have been received with favor in the French criminal courts. In "poroscopy," Dr Locard considers the number, form and position of body pores remain the same throughout all one's life. The impression of the pores, in his system, is colored by chemical vapors or very fine powders so they may be photographed with the aid of a microscope Graphometry consists in the theory that handwriting shows always a certain relation in size between letters and unmistakable characteristics in form, particularly of loops.

Conservation of Vanishing Species.—It is urged upon all biologists to exert "a more serious effort to rescue a few fragments of vanishing nature," including all forms. It is pointed out, through the medium of *Science*, that the appalling rate at which our native flora and fauna are disappearing is obvious to all except those workers whose outlook is bounded by the walls of their laboratories, and that the situation is accepted by these latter as more or less inevitable. That biologists, above all others, are in a position to appreciate the loss of a single species or of natural associations of species" is patent They are, furthermore in an advantageous position to bring out by propaganda and with the weight of authoritative counsel the value of this conservation Toward the furtherance of this end, a national organization has been proposed

"Blind as a Bat" Loses Significance.—An experiment conducted lately by English investigators points strongly to the conclusion that bats avoid colliding with objects during their swift nocturnal flights, not so much by their sense of sight as by their acute hearing A number of these animals were blindfolded and released in room crossed with many wires and having in one of the walls an aperture just ample enough to enable the bats to escape into an adjoining room They easily avoided the wires and flew through the holes without coming in contact with the partition. It was discovered that while flying they emitted a note almost inaudible to the human ear; and from this it was presumed that they perceived sound vibrations which were reflected from the obstructions, and were guided thereby.

Mount Everest Baffles Explorers.—The British expedition which is attempting the conquest of Mount Everest in the Himalayas, the world's highest peak, has completed its explorations to the north and west of the mountain without discovering a single practical route to the summit, it was announced in a cable dispatch from Simla dated August 27 Some hope is still entertained, however, that a route may be gained on the northeast flank of the great mountain, and when the monsoon abates another effort will be made. If the summit cannot be attained this year it will probably be reached next year. Meanwhile the headquarters of the expedition has been moved toward Kharta, upon which point the further effort will be based. The present expedition has surveyed about 10,000 square-miles of territory on and adjacent to Mount Everest.

Fabre.—The passing of October marks the sixth anniversary of the death of Jean Henri Fabre, whose chronicles of the lives and habits of the insects have been, perhaps, more effective in creating a love for these lowly animals in the popular mind than the combined writings of all other entomologists. His literary technique was of the very highest order This was the real secret of his fame—a belated fame, however, for living until the advanced age of ninety-two, it was not until the closing years of his life that he reaped the fruits of his labors. As one peruses the thrilling pages of his intimate life histories, the tremendous genius of the man forcibly impresses itself on the reader; at one stroke of his pen he has interpreted with scientific accuracy the ways of his animals, and has made them appear as dramatic and as interesting as the affairs of humans.

Civil Engineering Notes

Abstracts of Important Recent Papers and Published Articles

The Disposition of Old Ties is an item of no small inconvenience and expense to the railroads Increased labor costs makes it no longer possible to load them and haul them into terminals for engine wood. One solution has been found, applicable apparently in any scantily wooded section It is found that farmers and others near the right of way are willing to haul them away for fuel, and usually to perform some service in return such as plowing fire guards giving right of way for snow fences, etc

A Tunneling Machine of new design has just made its appearance. While there is nothing new in the idea of tunneling machines the present scheme is decidedly novel It comprises a boring head and a rotating tail arrangement by means of which the lining is placed At present the machine is being experimented with in Philadelphia with what are said to be satisfactory results. Eight men operate the experimental machine. As it advances and bores its way through solid rock the rotating tail places the lining in the tunnel thus finishing the job in one operation

The Resistance of Redwood to Rot is demonstrated in a remarkable fashion by the record of some water pipes of this material which has recently been put forward These pipes were not of the stave type but were actually bored from the logs. They were in use for sixteen years on the underground water system of a western ranch This system was torn up and the pipes piled in the open where they remained for ten years more weathering in the sun and rain They have recently been examined with the view to putting them in service again and are found to be in a condition fully justifying this step

Hydro-Electric Plans in Ceylon.—Surveying and plan-drawing in connection w th the Aberdern Laxapana hydro-electric scheme have progressed sufficiently to enable a fairly accurate estimate to be made of the cost of the work up to and including the generating stati n The survey and location of the high tension transm ssion lines has begun To carry out the s heme on a less expensive basis it has now been decided to develop the Kehelgamu-oya first and bring in the water of the Maskeliya-oya at the third stage. This will not interfere with the final output. The report of Mr Bolton who was sent to Ceylon by the Brit sh consulting engineers shows that cyanamide could be produced in the island at less than the present price of the imported article.

Drainage of Zuyder Zee—At the Inland Shipping Congress held at Rotterdam recently the drainage of the Zuyder Zee formed the most important subject of discussion It was pointed out that the drainage would necessitate the construction of a number of new canals One speaker pleaded that the building of new villages and factories in the polders should not be left to mere chance. Villages with churches should be built near the canals but industrial works near the dykes. Such an arrangement would prove of advantage to shipping and would prevent any pollution of the polder water A number of the waterways connecting the Zuyder Zee ports are to be preserved but wherever polders form a continuation of the existing land new harbors will have to be made

Motor Transport in Syria.—Since the French occupation of Syria great attention has been paid to roadmaking and good results have been obtained The Lebanon especially has a large extent of good driving roads. His Majesty's Consul-General at Beirut says that conditions are therefore favorable for motor transport. There has been a considerable import of motor-cars during the past year American cars greatly predominate owing to their cheapness Their lightness and power suit them for the rough roads and arduous climbs. British low priced cars are not sufficiently powerful for the climbing while the higher-priced ones are too dear for the market or too heavily built. Owing to the small carrying capacity of the Damascus Railway under present conditions and to the high rates merchants even now find it cheaper to transport goods to Damascus by road Lorries and vans are also in use in Beirut itself and in the coastal regions

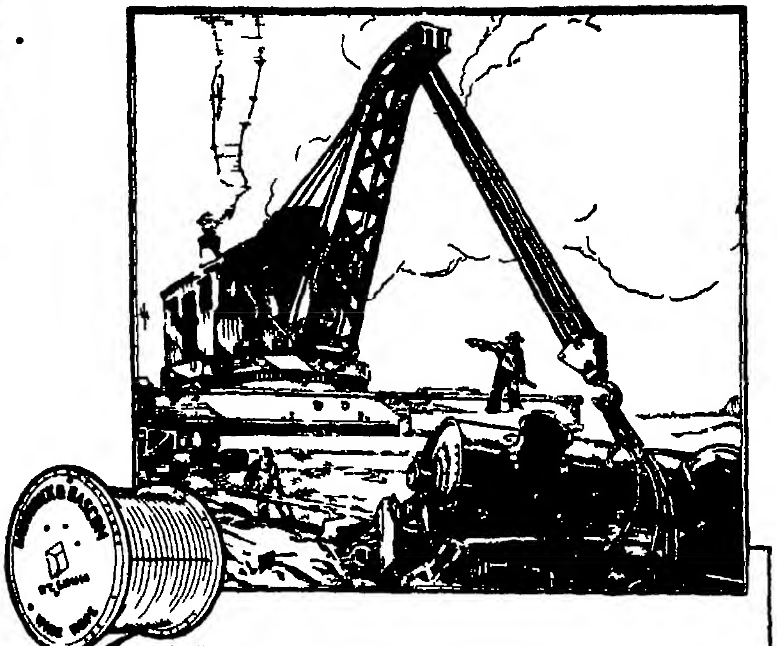
Anchor Tie Plates.—Safe track is the first requisite for safe and profitable railroading The only safe track is the track anchored to resist all forces that tend to make it creep or move in any direction According to a Middle West manufacturer his anchor tie plate with a special key absolutely prevents the spreading creeping or lifting action of rails and prevents even the least movement at such critical points as interlockings, crossings, radial tracks or insulated joints. Not only is the rail held from creeping both ways, but the expansion distance between rail ends kept as can only be done by two-way anchoring of the rails. The holding of the rail flange by the lip of the plate on one side and by the key on the other gives a rail base width equal to the length of the plate. This enormous advantage, as it is claimed, is secured only by this plate. The maintenance of plate is slight, nor does it require that ballast be disturbed to protect it. The key prevents the "necking" of spikes. Spikes are always driven straight and are always straight when withdrawn

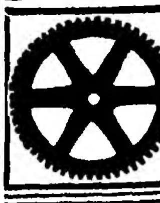
Ship Concrete in Germany.—German engineers are applying concrete for ships with a view to getting a light strong and impermeable material, we learn from a contemporary As a result some experimenters are recommending adding to portland cement 10 to 25 per cent pulverized calcined limestone and 20 to 35 per cent of a pulverized silicate of magnesia preferably white talcum rich in silicates and containing no chlorides To this carefully prepared mixture some of the well-known porous ingredients are added and then the substance is stored in a dry and airy place Thereafter it is used for preparing the concrete in the same way as ordinary cement would be used but in a richer proportion The concrete obtained therefrom by casting or ramming is light waterproof elastic acid proof and tough is reported to possess the good qualities of concrete for shipbuilding purposes in a higher degree than concrete made of pure portland cement A great deal of experimenting is going on b th in Germany and Austria in concrete ships and barges particularly the latter for use on the inland waterway systems.

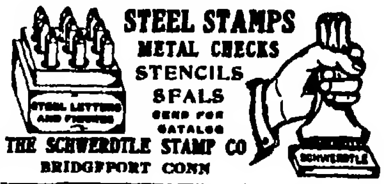
Detroit's Proposed Bridge—Development of the plans for the Detroit River bridge to connect Detr it and Windsor a project that has been under consideration during the past two years has progressed far enough to put into concrete form some of the outstanding features of the proposed structure in a recent issue of *Engineering News-Record*. We learn that a span of 1808 feet from center to center of towers will be required and for this purpose a suspension br dge with unloaded backstays carrying two decks for separate accommodation of railway and highway traffic has been designed The plan has been adapted to the requirement of construction in two stages the highway deck to be constructed first and the railway deck to be added later together with the cables and extra stiffening truss capacity required to take care of it The towers of steel consist each of four posts in the vertical planes of the four pairs of cables (one pair to each stiffening truss) A sag ratio of one-tenth has been adopted with stiffening truss depth one-fiftieth of the span length a sag ratio of one-ninth and a truss depth of one-sixtieth are being investigated for economy deflection and general appearance of the structure

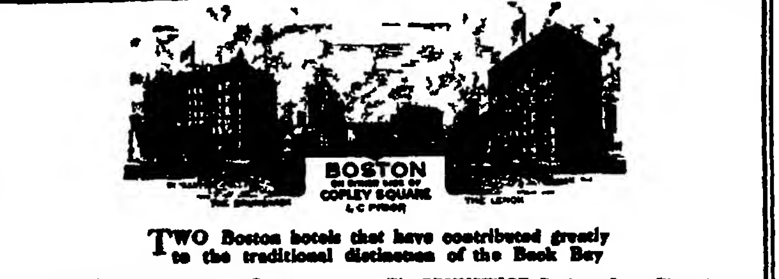
Quick Hardening Cement. In the course of the world war states Edwin C Eckel in *Engineering News-Record* a cement of very remarkable type and properties was put into use by the French for special military purposes. Its high technical value in certain limited fields is such as to make it advisable to discuss briefly its characteristics As an introductory summary we may say that it is lime aluminate differing from normal portland cement in the almost total absence of silica that it is prepared by actual fusion not by mere clinkering that it is almost white in color and that it will harden with such rapidity as to make a good heavy gun platform within 24 hours So far as cost of manufacture is concerned the fused cement can obviously be made at least as cheaply as a normal portland Its uses will be determined then not by cost, but by its special characteristics, which give it value in certain fields of work but limit its use in other lines Considering the composition of the fused cement its most remarkable property perhaps is its resistance to the decomposing effects of sea water and similar solutions, for until this Lafarge cement was introduced there was a tendency to ascribe the breaking up of portland cement in sea-water to its content of alumina and to search for cements low in alumina

Novel Steel Sheet Piling Cofferdam. In developing additional horsepower for the hydro-electric plant of the Niagara Falls Power Company to meet the needs of the War Department a great many obstacles were encountered and subsequently overcome by the engineers of a steel sheet piling manufacturer In the construction of the forebay it was necessary to build a cofferdam that would restrict the flow of the hydraulic canal as little as possible so as not to interfere with the operation of Station No. 3 as it was imperative to keep all the old plants running to their utmost capacity during the Summer and Fall of 1918 This cofferdam was located along the old west wall of the canal basin which previous to its removal acted as a natural cofferdam for the required excavation. After a thorough analysis of the different methods of construction under consideration the engineers of the power company decided that a narrow cofferdam composed of a number of cells or pockets was best fitted to meet their requirements. The cofferdam finally adopted consisted of eighteen oval-shaped pockets formed with straight-web piling varying in length from 16 feet to 24 feet. In constructing the cofferdam timber trusses were first built and floated to position along the old concrete wall after which timbers shaped to fit the outside of the pockets were fastened upon the cofferdam side of the truss Templates made of two thicknesses of 2-inch plank conforming to the inside of the pockets, were then floated into place and the steel sheet piling was assembled around them and against the truss As soon as one pocket was assembled, the piles were then driven with a light steam hammer through any loose rock which might lie on the bottom of the basin This driving also caused the ends to fit as closely as possible in the solid rock. After the driving was completed, the driver examined the pocket and closed any openings that were found to exist between the piling and the rock, with bags partly filled with concrete.









Britain's New Battle Cruisers

(Continued from page 367)

weapons. Had military and technical considerations alone prevailed, there is little doubt that the new British battle cruisers would have been armed with 18-inch batteries. But the Cabinet, according to rumor opposed such an armament on the ground that it might be construed as a challenge by other Powers, notably the United States and Japan, and inaugurate a new international competition in "tons and guns"—a development which British statesmen are particularly anxious to avoid This is probably the first time on record that the design of British fighting ships has been influenced by diplomatic considerations, but, looking at the matter in a broad light, few will question the sagacity of the Cabinet's attitude. Japan at any rate, is known to have designed an experimental 18-inch gun, if she has not actually built one and as for the United States, it is all but certain that the later capital ships of the current program would have been re-designed for an 18-inch armament had weapons of this caliber been selected for the British battle cruisers.

But the Naval Staff having been denied the 18-inch gun was determined that its new ships should not be inferior to their foreign contemporaries, and therefore resolved to introduce the 16-inch model which had previously been adopted for the capital ships of the United States and Japan

The New 16-Inch Gun

As shown in Vickers list, the new gun is 741 25 inches in length the bore being 720 inches long and the total weight 117 tons. The armor-piercing projectile weighs 2240 pounds and is fired with a muzzle velocity of 2450 foot-seconds and an energy of 93 230 foot-tons. With an uncapped projectile the penetration of wrought-iron plate at the muzzle according to the Gavre formula is 57 inches. The maximum rate of fire is 1 2 rounds per minute A shorter model of the same gun, 42 65 calibers in length weighing 107¾ tons and firing a 2461 pound shell, is also listed by Vickers. In both cases the weight of the projectile it will be noted, exceeds that of the American 16-inch shell though the muzzle velocity is less. As mounted in the new ships the 16-inch gun will be capable of elevation up to 35 degrees, at which angle the extreme range will be over 40,000 yards. Apart from the increased range obtainable the advantage of giving the main guns a generous angle of elevation is that it enables them to keep bearing on the target even though the ship be listing heavily as the result of damage on or below the waterline.

British Adopt 3 Gun Turret

The turrets will be of a new pattern built up of 15-inch or 16-inch armor on the exposed parts with a flat roof that will offer no "bite" to descending shell Each of the three guns in the turret will have independent elevating gear All the turret machinery will be hydraulic for although British naval engineers are fully alive to the merits of electricity for this purpose they still believe in the all-round superiority of the hydraulic system

The secondary battery will comprise 16 rapid-fire guns of 5 5-inch or 6-inch caliber Although introduced only six years ago the 5.5-inch has become popular in the Navy owing to its light weight compared with the 6-inch and its very high rate of fire. The projectile weighs 82 pounds, and is considered sufficiently heavy for the attack of hostile destroyers or submarines. Each of the new ships may carry as many as 12 torpedo tubes all or nearly all mounted above the waterline. Professional opinion has turned against the submerged tube owing to its repeated failures during the war Torpedoes fired from these tubes when the ship was traveling at high speed did not run straight, apparently because the sliding bar or "spoon," failed to protect the torpedo from the lateral pressure of water as it emerged from the tube. Moreover there were several cases of the bars bending under the strain and more than one ship had to return to dock yard to have a buckled torpedo bar withdrawn For these reasons the modern tendency is to mount torpedo tubes above the waterline where they occupy much less space and are far simpler to operate.

"New 'Hoods' To Be Built Slowly

According to present plans, the four new battle cruisers are all to be in commission early in 1925 Their keels will be laid during the coming winter, and the building period is to extend over 36 months. Not more than £2 500 000 is to be expended on the work during the current fiscal year which terminates on March 31 No credence should be attached to recent rumors that the British Admiralty has a further big program of construction up its sleeve. Future British naval policy will, of course, be influenced by the outcome of the Washington Conference, and it is a fact that the people of Britain fervently desire a happy issue both on political and economic grounds. Burdened as they are with a heavy load of war debts and crushing taxation they are not prepared to sanction any ambitious schemes of naval aggrandizement which cannot be shown to be absolutely vital to the national safety It is true that the four-ship program, involving a total first cost of about £24,000,000, has been accepted without serious criticism, but this is because the country realizes that unless something is done at once to replace obsolete material the British Navy [illegible] a first grade Power with [illegible] in three years' time and the [illegible] would [illegible] on sufferance.

A [illegible] by [illegible] that the new [illegible] approximate to the ideal [illegible] by British naval [illegible]. Not only has their design, as mentioned [illegible], been influenced by political considerations, but the Admiralty constructors have had to work within a definite financial limit, which compelled them to keep within relatively modest dimensions. The "ideal capital ship" as defined by Sir George Thurston, Vickers' well-known designer, would be a vessel 960 feet in length, 112 feet broad, drawing 31½ feet of water and displacing 57,000 tons at normal draft. She would have machinery of 500,000 S. H. P. for a speed of 35½ knots, and be armed with a main battery of eight 20-inch 45-caliber guns. Monsters such as this may possibly be afloat in a few years' time, but it is more than doubtful whether the first of them will fly the British flag

Railway Conditions in Soviet Russia

THE following observations on railway conditions in Siberia and European Russia are from a source which the Bureau of Commerce considers reliable and are of recent experience

On the main line of the Transsiberian Railway the roadbed seemed to be in good condition all the way Section hands and trackmen employed under the old régime have remained at their posts, despite arrears in their pay and have made the necessary repairs to track ballast. Telegraph lines are also in good condition and fully half the poles have been renewed during the last two years, according to the date marks on them A number of stops were made en route on account of delays in transportation

The rolling stock of the railways is in a very unsatisfactory condition, chiefly due to lack of spare parts for repairs. This is especially true of locomotives. The yards in practically every terminal were filled with locomotives that had been junked. There seems to be a large supply of box and gondola cars, although many of them have been requisitioned on sidetracks to house soldiers and in some cases refugees. There is great shortage of passenger cars, and all of them are in bad condition. Hot boxes were very frequent all along the lines on account of worn-out bearings and inferior oil.

Trains are running regularly three times a week from Irkutsk to Omsk, taking four days for the journey and to both Petrograd and Moscow requiring from four to five days each A large number of the passengers on these trains are soviet officials, as it is exceedingly difficult for civilians to secure permission from the authorities to travel A large number of civilians, however were traveling with their possessions in freight cars in both directions.

The north route to Perm and the routes from Moscow to Petrograd, Reval and Riga are in fair condition but the southern routes to the Urals and many of the others in central and southern Russia have been partially or completely abandoned.

A German commission is in Moscow negotiating for the operation of some of the railway lines.

The following statement of railway conditions in 1921 is summarized from information published in official soviet papers

Conditions of rail transport have rapidly grown worse during May and June The number of locomotives repaired during recent months is very low The program for rail transport has been reduced by 40 per cent, but even this program will not be carried out. Many unfit cars, with broken roofs and bodies are lying on the tracks awaiting repair which has been ordered.

The rapidity with which the situation grows worse is shown in the following data on cars for the 10-day period, June 11-20, 1921 During that time 415 656 cars were accounted for excluding tank cars, and were distributed in the main as follows Unfit for use, 9615 as against 8786 in the previous 10-day period; under repair 119 384 as against 115,922 in the previous 10 days used as stores and living rooms 26 000; in economic trains (presumably for railway needs, construction repair etc) 30,557; in passenger trains, 14,247 in reserve, 532 empty 31 306; actually working 170 710 as compared with 173 964 during June 1 10

In addition about 12 600 tank cars (decreased during May and June from 15,300) were in operation, carrying crude petroleum and kerosene etc from the Caucasus to various southern railways.

The actual use being made of cars in service is shown in the following data on distribution of loaded cars per day during the period June 11-20 as compared with June 1-10 Military transport, 1446 and 1596, respectively; food transport for Soviet Food Commission, 1491 and 1398, respectively food transport from foreign trade, 411 and 491 respectively; fuel (except petroleum) 3114 and 3181, respectively in economic through trains, 300 and 121 respectively; in economic local trains, 897 and 1086, respectively; goods for Supreme Economic Soviet, 700 and 680 respectively; building materials, 172 and 196, respectively; various goods, 300 and 340 respectively; under orders of Commissariat [illegible] 123 and 113 respectively It appears that loaded cars decreased in [illegible] though there [illegible] from the [illegible] and that the largest number of cars was used in [illegible] coal and wood fuel, military [illegible] supplies—in the order named.

[illegible]

INDEX FOR THE WEEKLY SCIENTIFIC AMERICAN INCLUDING OCTOBER 15, 1921 ISSUE

Note.—Illustrated articles are marked with an asterisk(*). Look for the general subject rather than the supposed specific title of any article. Thus "Aeronautics," "Automobiles," "Meterology," "Canals," etc., will give related articles much more quickly than by reference to the title of the article.

Lack of space prevents the use of many cross-references.

INDEX FOR NEW MONTHLY SCIENTIFIC AMERICAN

Because of the change from the former weekly edition to the new monthly, the index for this volume is given in two parts. The foregoing one is devoted to the issues of the regular weekly up to and including the issue of October 15th, while the section that follows below is devoted to the November and the December issues of the new monthly SCIENTIFIC AMERICAN

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Date of issue.	Date of issue.	Date of issue.